Sewaren Peninsula Feasibility Study

Woodbridge, New Jersey

Prepared for: Township of Woodbridge,
New Jersey

By: Sasaki Associates, Inc.
64 Pleasant Street
Watertown, Massachusetts

with: Cross Group, Inc.
Matawan, New Jersey

November 1981

ACKNOWLEDGEMENTS

This acknowledges the financial assistance provided by the Coastal Zone Management Act of 1972, as amended, with funds administered by the National Oceanic and Atmospheric Administration, Office of Coastal Zone Management. This study was prepared under the supervision of the New Jersey Coastal Energy Impact Program of the New Jersey Department of Energy. However, any opinions, findings, conclusions or recommendations expressed herein are those of the author(s) and do not necessarily reflect the views of NOAA or N.J.D.O.E.

SEWAREN PENINSULA

FEASIBILITY STUDY

WOODBRIDGE, NEW JERSEY

For The

TOWN OF WOODBRIDGE

By

Sasaki Associates, Inc.
64 Pleasant St.
Watertown, MA 02172

And

Cross Group, Inc.
123 Main St.
Matawan, N.J. 07747

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

1.1 Purpose and Objectives

This report was prepared in order to provide information necessary for the development of a conceptual master plan for recreational use of the 36-acre Sewaren peninsula site. As a site feasibility study, the objectives were as follows:

1. Examine the site's existing conditions including land use, physical characteristics, utilities and special features.

2. Conduct an engineering analysis (including costs) of alternative marina and park designs to aid in the selection of a workable design solution.

3. Develop a park/marina master plan which reflects the community's desires for additional recreational facilities and is feasible from both an engineering and environmental standpoint.

4. Conduct an environmental analysis of the master plan, recommend mitigation measures, and identify permitting requirements.

5. Prepare a cost estimate of the master plan and identify possible sources of funding.

1.2 Field Reconnaissance and Inventory

The site was inspected by Varoujan Hagopian, Coastal Engineer (Sasaki Associates, Inc.), on 25 June 1981. Observations were made of the wave climate, erosion/accretion regime, surficial soils, currents, access, visual qualities and general site conditions. Also during this site visit, several inquiries were made to the Corps of Engineers and marina operators along Smith Creek concerning water quality, vessel mix, navigation hazards, permitting, dredging frequency and tidal data.

On 28 July 1981, Ellen Chagnon, Aquatic Ecologist (Sasaki Associates, Inc.), made observations regarding wetlands, topography, vegetation, land use and drainage.

During the course of these site visits and following the field inspections, contacts were made with appropriate agencies to obtain data pertinent to evaluating the technical and environmental feasibility of developing recreational facilities on the site. A listing of the contacts made is presented in Table 1.

TABLE 1

C O N T A C T S

Purpose/Issues	Contact
Coastal Project Review	Barbara Kauffman Coastal Grants Coordinator N.J. Dept. of Environmental Protection Division of Coastal Resources Bureau of Coastal Planning and Development Darryl Jennus N.J. Dept. of Environmental Protection Division of Coastal Resources Bureau of Coastal Project Review William Dargay, Regional Supervisor N.J. Dept. of Environmental Protection Division of Coastal Resources Bureau of Coastal Enforcement
Green Acres Program - funding, development issues	Dennis Davidson, Director Green Acres Program
Permits prior to funding	Bob Rusch Green Acres Program
Fishing and Crabbing	Various crab fishermen
Dredging frequency, siltation, navigation	Mr. O'Halloran, Operator Riley Boat Yard
Wave climate, storms	Various Boat Operators and Owners
Dredge Disposal Permits	O. Martino U.S. Army Corps of Engineers New York
Ocean Disposal	Mr. Creamur U.S. Army Corps of Engineers New York
Channel and Waterway Maintenance	P.J. Puglese U.S. Army Corps of Engineers New York

Purpose/Issues	Contact
Wave climate/erosion	Gilbert Hersesian, Chief Coastal Engineer and Jim Urbelas, Coastal Engineer U.S. Army Corps of Engineers New York
Dredging frequency	John Garofalo N.J. Dept. of Environmental Protection Division of Coastal Resources Bureau of Coastal Engineering
Fish and Wildlife Endangered Species	Oliver Edstrom U.S. Fish and Wildlife Service Absecon, New Jersey N.J. Dept. of Environmental Protection Division of Fish, Game, and Wildlife Office of Non-Game Species
Dredging Costs	Mr. Lindholm Great Lakes Engineering Union, New Jersey Jim Wayne U.S. Army Corps of Engineers New York Gates Engineering Corp. Bill Gingerich Simpson and Kenlan Frank Jannuzzi Weeks Construction Cranford, New Jersey Chris Kirk Gibson and Cushman Long Island, New York
Utilities	Ted Grundmann Middlesex Water Co. 1 Woodbridge Center Woodbridge, New Jersey Angelo Valetutto, P.E. Woodbridge Engineering

In addition to agency contacts, a literature search of existing data also was conducted. Woodbridge authorities provided much of the base-line data for the site. A bibliography of all reports, maps, and plans consulted during this study is presented in Appendix I.

2.0 EXISTING CONDITIONS

2.1 Locus and Land Use Context

2.1.1 Locus

The proposed Sewaren Waterfront Park is to be located on a 36± acre portion of the Sewaren Peninsula in Woodbridge, New Jersey. The site is approximately 1.5 miles from the center of Woodbridge and is bounded on the east and south by the Arthur Kill, on the west by Smith Creek, and on the north by a sewage treatment facility (Figure 1).

2.1.2 Historical Land Use

The Sewaren peninsula area historically has been used for waterfront recreation. In 1880, a waterfront resort (Boynton Beach) was developed along the Arthur Kill just to the south of the peninsula. This resort, which included a bathing beach, dance pavilion, picnic area, and amusement park, was extremely popular during the 1890s and early years of the 20th century.

During this same period, a social club (Sewaren Land and Water Club) was established on the waterfront along Cliff Road. This club, a witness of the time when the area was valued by wealthy society, was destroyed by a hurricane in the 1940s.

Beginning with the 1920s, the area became industrial. In 1927, the Boynton Beach property was purchased by Shell Oil Company for use as an oil storage facility (its present use). Following Shell Oil Company's lead, additional property was purchased by Royal Petroleum, and Public Service Electric and Gas Company.

The proposed waterfront park site long has been used as a dredge disposal area and is essentially man-made land. No historic or archaeologic features are known to exist on this site.

2.1.3 Land Use

The Sewaren peninsula is presently an undeveloped open space resulting from placement of dredge spoils. Adjacent land uses shown on Figure 2 are a

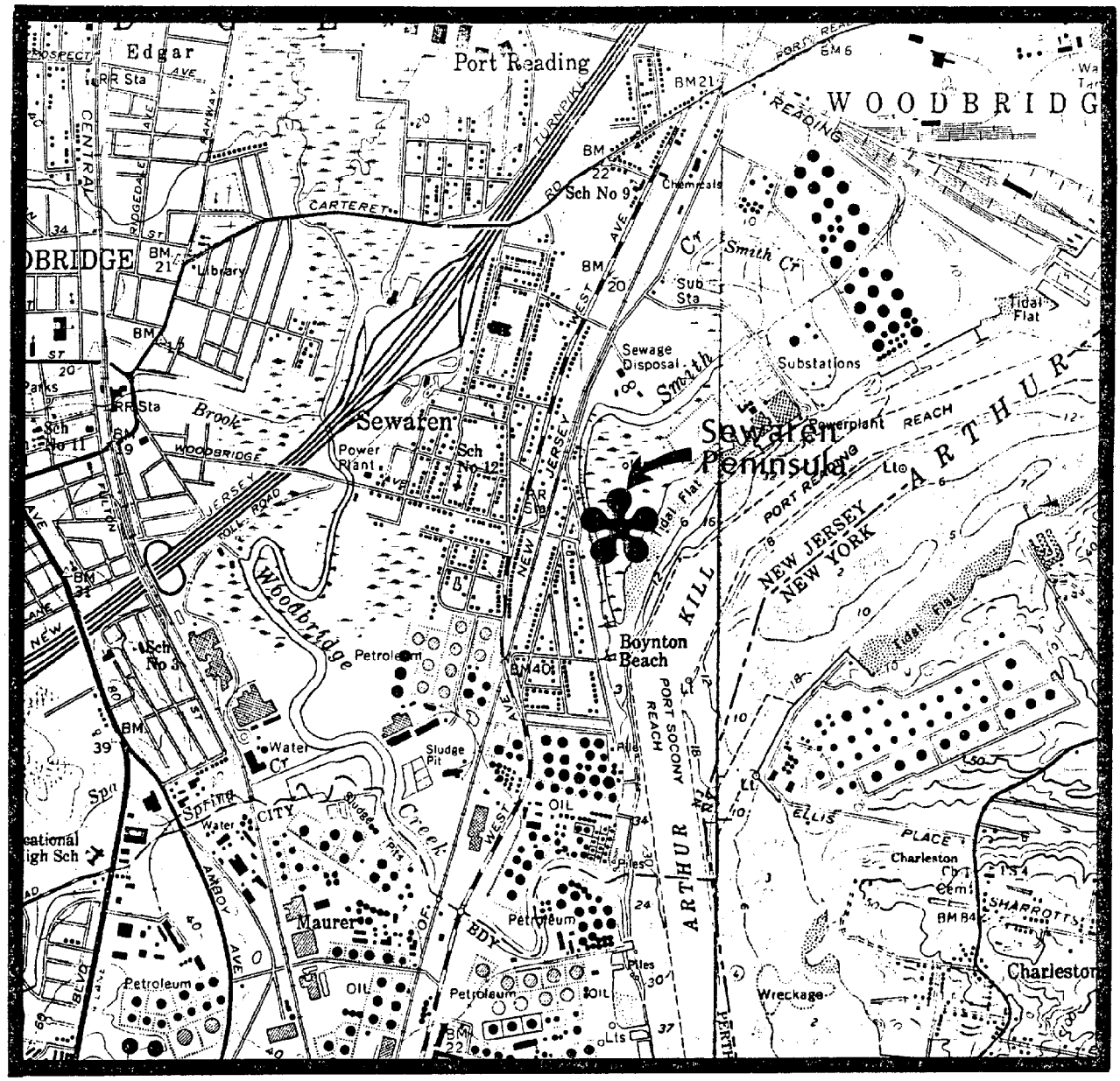
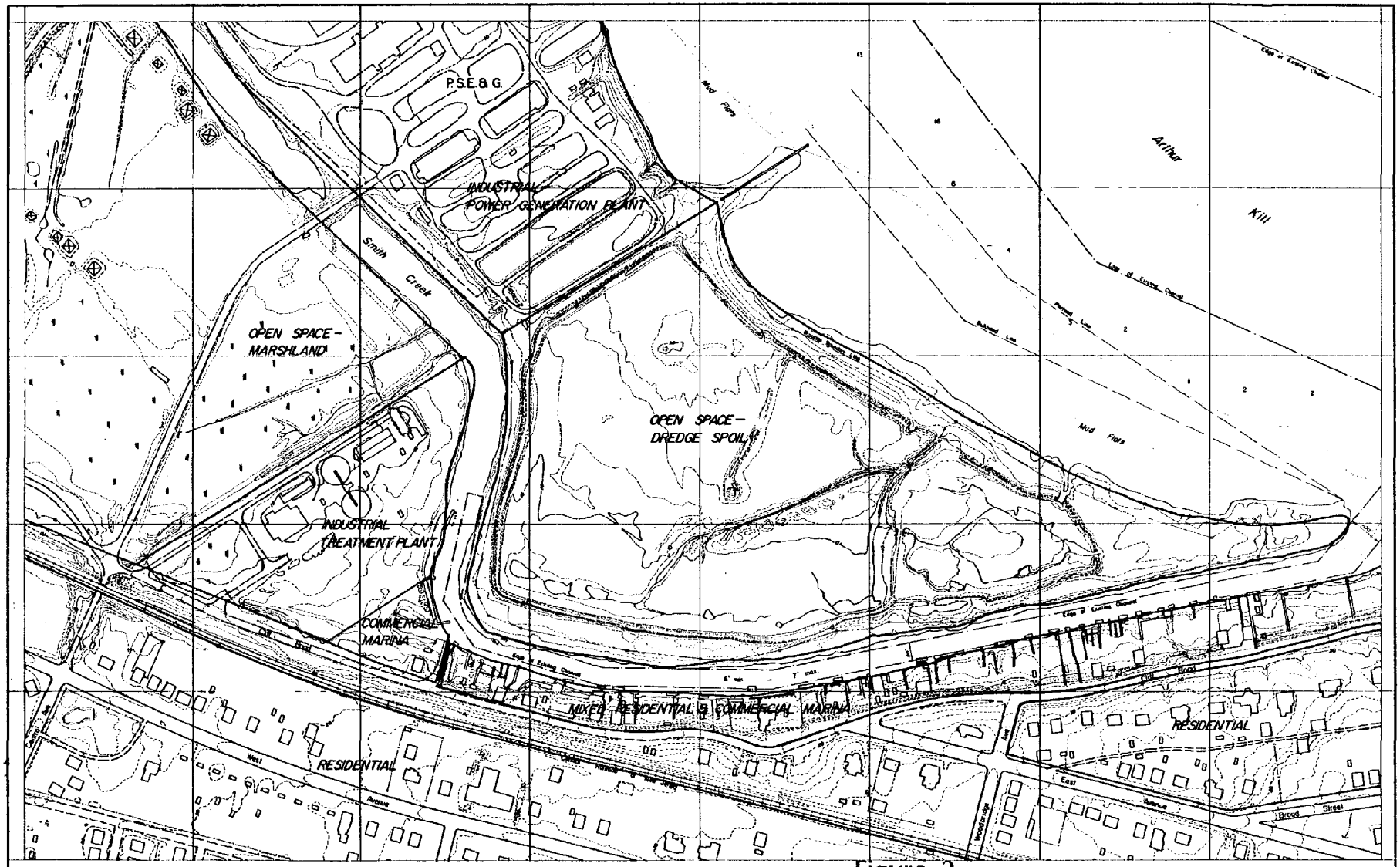


Figure 1

Site Locus



Sasaki Associates, Inc.
Watertown, Massachusetts

Cross Group, Inc.
Matawan, New Jersey

Sewaren Waterfront Park

Woodbridge, New Jersey

Figure 2
Land Use

North

0 100 200 feet

SA No. 0278

power generation plant, open space marshland, mixed residential and commerical marine operations, and a Town of Woodbridge sewage treatment plant.

The sewage treatment plant is scheduled for decommissioning in the future. With this exception, all other land uses appear to be stable and no major shifts are expected or assumed for purposes of this Report.

It is proposed that a waterfront related land use replace the treatment plant in the future.

The sources used to compile land use data were field surveys and air photo interpretation.

2.1.4 Zoning

Sewaren peninsula is presently zoned R-6, High Density Single Family Residential. Adjacent zones are M-2, Heavy Industrial Zone of Public Service Electric and Gas lands and B-1 Neighborhood Business Zone along the west bank of Smith Creek. See the Zoning Map, Figure 3.

Apart from the juxtaposition of Heavy Industrial and High Density Single Family Residential zones, the desirability of housing is thought to be low when compared with the more accessible Public Park land use recommended by this Report.

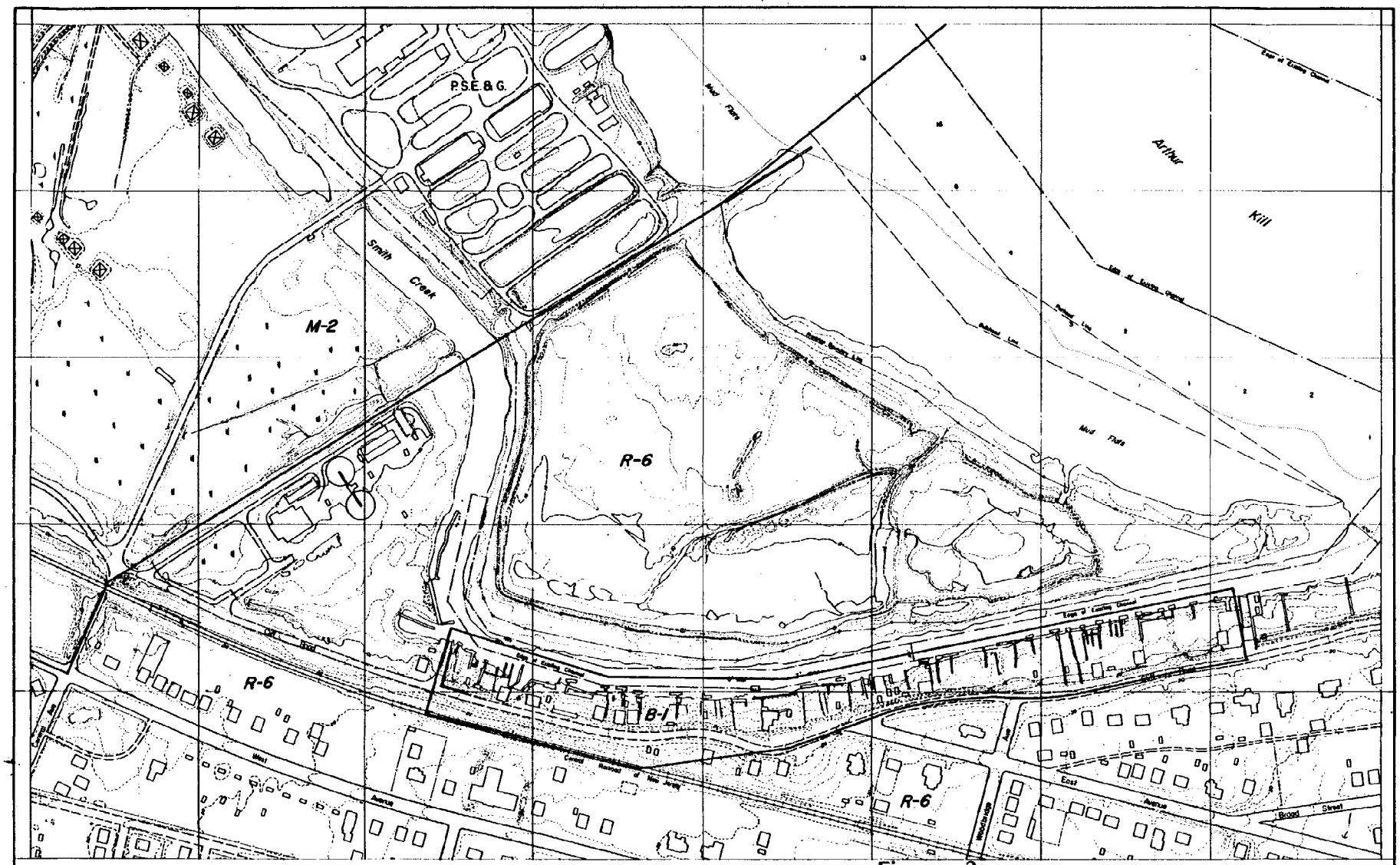
A zoning variance may be necessary changing the Sewaren peninsula to a Park and Recreation zone with a portion of the site named B-1 Business Zone, which is congruent with the Boat Basin and Restaurant and Harbor Master facilities. The source of Zoning data is the Town of Woodbridge zoning ordinance 1979.

2.1.5 Property Ownership

Parcel Ownership is shown on Figure 4. The Township of Woodbridge has title to two large parcels; 1) The Sewaren peninsula comprises a 27.4 acre tract, not including Riparian lands held by the State of New Jersey (8.6 acres) and 2) the Sewage Treatement Plant tract of approximately 8.7 acres.

The largest abuttor is Public Service Electric and Gas Company. More than 100 small lots front on Cliff Road and also abut the Sewaren peninsula on the west shore of Smith Creek.

The source for property ownership information shown in Figure 4 was Town of Woodbridge Assessors Tax Maps.



Sasaki Associates, Inc.
Watertown, Massachusetts

Cross Group, Inc.
Matawan, New Jersey

Sewaren Waterfront Park

Woodbridge, New Jersey

Figure 3
Zoning

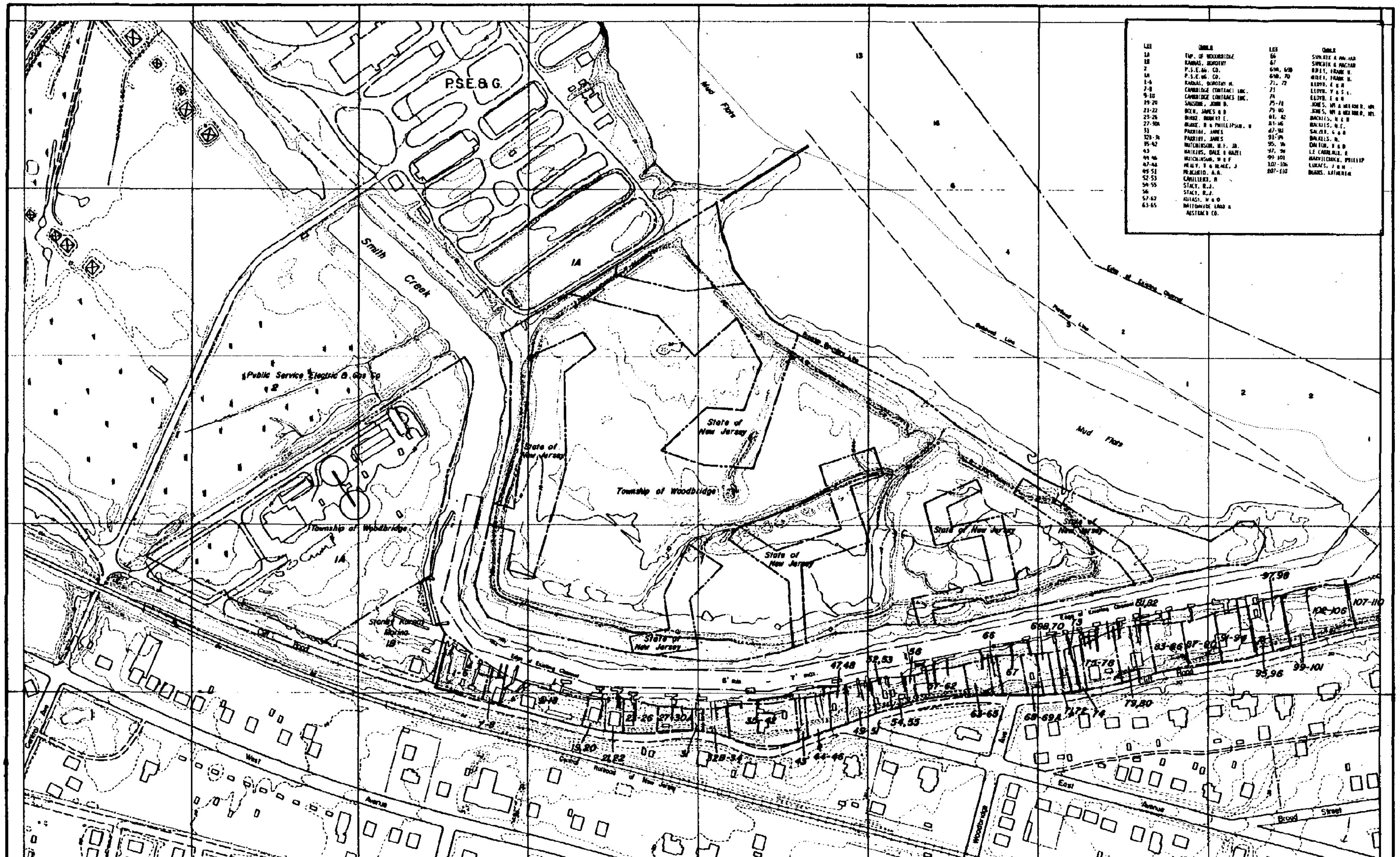
Legend
R-6 High Density Single Family Residential Zone
B-1 Neighborhood Business Zone
M-2 Heavy Industrial Zone

North

0 100 200 feet

Source: Town of Woodbridge Zoning Ordinance

SA No. 0278



Sasaki Associates, Inc.
Watertown, Massachusetts

Cross Group, Inc.
Matawan, New Jersey

Sewaren Waterfront Park
Woodbridge, New Jersey

Figure 4
Property Ownership

North

0 100 200 feet

SA No. 0278

2.1.6 Riparian Rights

The State of New Jersey controls the Riparian Rights to 7 parcels within the boundary of the Sewaren Penninsula tract owned by the Town of Woodbridge. (Figure 5). These remain in effect although the spoil drainage pattern no longer falls within the old Riparian streams.

Request for transfer of the Riparian lands ownership will be made in conjunction with permit and funding applications in later stages of the planning process. Ownership of these lands is essential to the development of the Alvin P. Williams Memorial Park. It is also recommended that the Town of Woodbridge purchase a small piece of Riparian land along Smith Creek in order to make more efficient layout of the boat slips, finger-piers, and fuel dock. The cost of aquiring the Riparian lands from the State of New Jersey is being discussed by the State and the Township of Woodbridge presently.

The source of Riparian Rights information is the Township of Woodbridge, Sewaren Penninsula Riparian Boundary Survey, May 1977, with Revisions, November 1980.

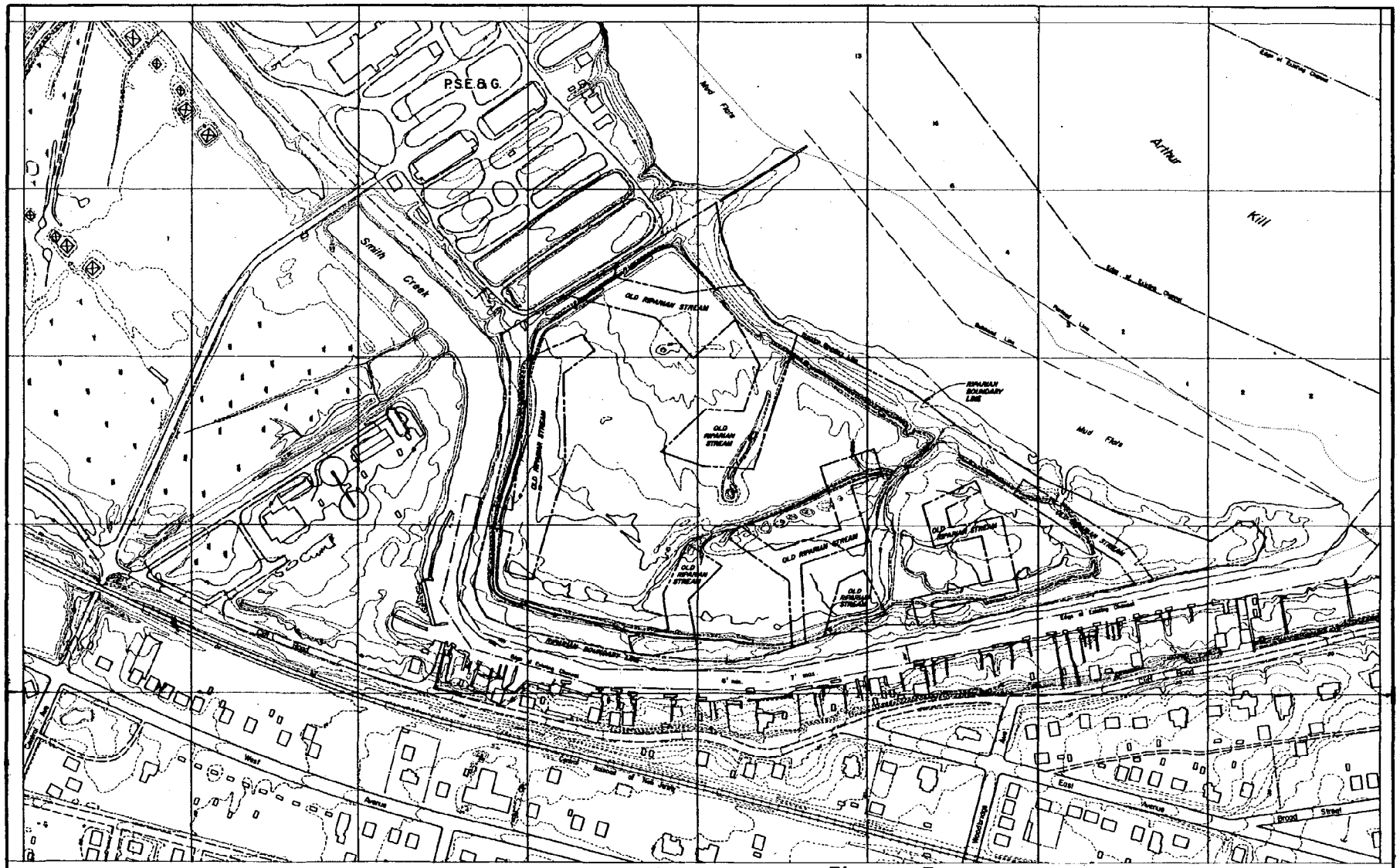
2.2 Access

Access presently is provided by an unimproved drive which intersects Cliff Road, crosses Smith Creek and services the Public Service Electric and Gas (P.S.E. & G) generating station northeast of the proposed site. Since this roadway (particularly its intersection with Smith Creek) is inadequate to support anticipated future use, a new access roadway is proposed as part of the Waterfront Park Master Plan. Under the master plan, a new crossing of Smith Creek will be constructed at the northeast corner of the park (this will allow removal of the existing crossing). A temporary access road will be constructed south of the sewage disposal facility (located north of the proposed park) from Cliff Road to the site. Following closure of this treatment facility, a permanent roadway will be constructed through the area now occupied by the facility (see Sewaren Waterfront Park Master Plan).

2.3 Physical Characteristics

2.3.1 Topography and Drainage

As a dredge spoil site, the peninsula is relatively level. Most of the parcel is at elevation 10 feet, National Geodetic Vertical Datum (NGVD), although occasional mounds rise to 20 feet. The perimeter of the disposal area is diked to an elevation of 16+ feet (NGVD).



Sasaki Associates, Inc.
Watertown, Massachusetts

Cross Group, Inc.
Matawan, New Jersey

Sewaren Waterfront Park

Woodbridge, New Jersey

Figure 5
Riparian Rights

North

0 100 200 feet

Source: Township of Woodbridge, Sewaren Peninsula
Riparian Boundary Survey, May 1977, with Revisions, November 1980.

SA No. 0278

All site drainage exits the parcel via an open out-flow channel on the eastern side of the peninsula, and enters the Arthur Kill. Runoff essentially is uncontrolled. The existing topography and drainage pattern is presented in Figure 6.

2.3.2 Geology and Soils

Geology

The entire site is underlain by a marine tidal marsh (Rutgers University, 1953). This unit consists of a decomposed organic mat, two to five feet thick, which rests upon organic sand, silt, clayey silt and clay to variable depth. This marsh formed at the confluence of Smith Creek and the Arthur Kill (Figure 7).

Smith Creek forms the boundary between two major geological units. On the east lies the site and marsh deposits, on the west shore and extending inland is glacial till. This is a deposit of unconsolidated material ranging from boulders to clay-size particles which were deposited by continental glaciers. Locally, this material may be quite sandy.

Much of the 36-acre site has been covered by 10 to 15 feet of hydraulic fill (dredged spoil) consisting of fine sand and silt. Levees were built around the perimeter of the site to contain the fill. The dredged spoil was placed over the tidal marsh as a slurry and allowed to de-water in place. The fill now forms the surficial deposits. Bedrock lies at depths ranging from 60 to 150 feet below the surface.

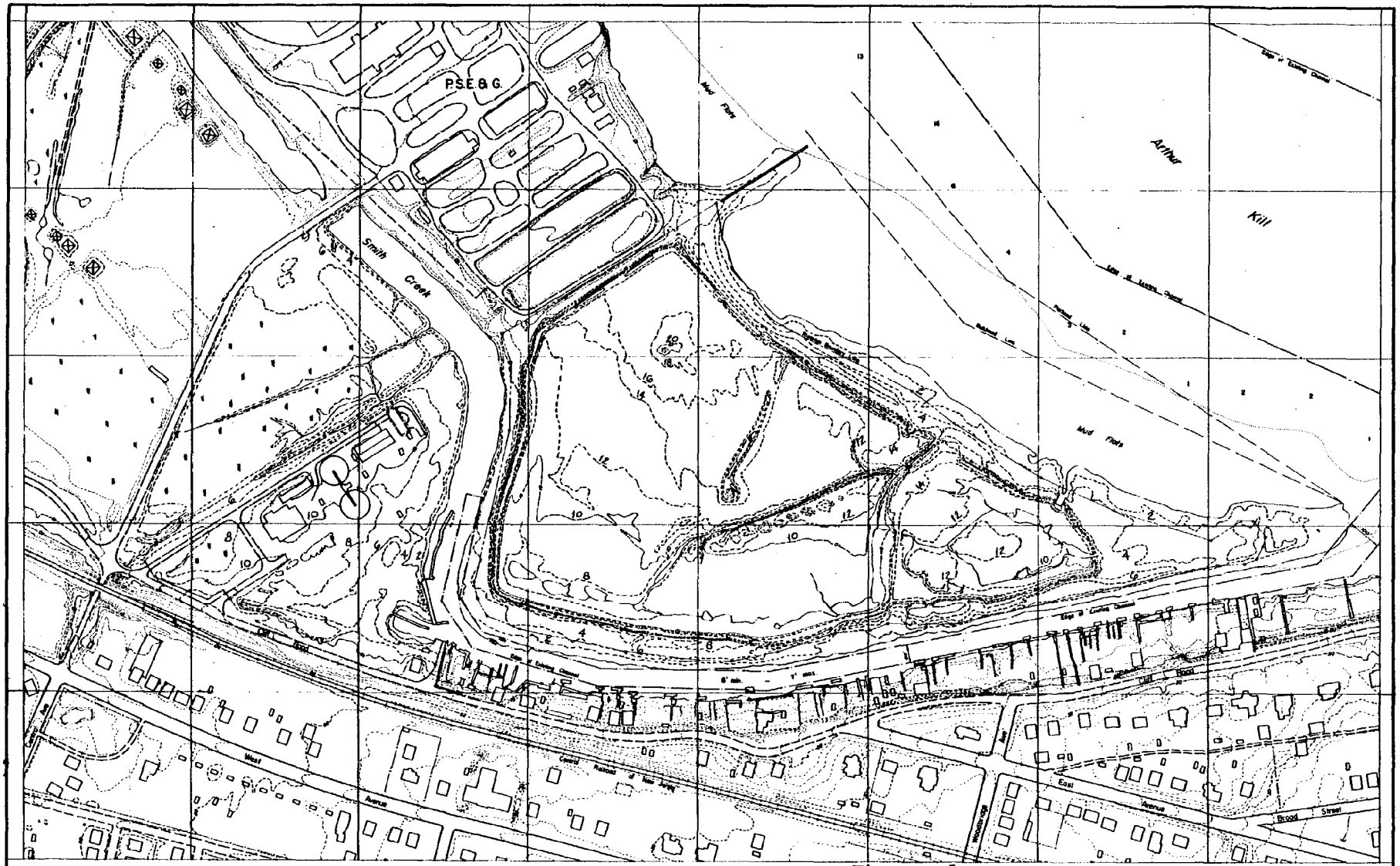
Soils

The U.S. Department of Agriculture, Soil Conservation Service has mapped the soils of the site. Their findings corroborate the surficial geology (Figure 8). The site consists of man-made land which was placed over tidal marsh deposits. All soils west of Smith Creek have been disturbed by urban development.

Subsurface Data

All existing subsurface soil borings and analyses available from the surrounding area were obtained from the Town and are included with this report (Appendix II).

Boring locations are presented on the Surficial Geology Map (Figure 7) and are between 150 and 1,000 feet from the northeast side of the site.



Sasaki Associates, Inc.
Watertown, Massachusetts

Cross Group, Inc.
Matawan, New Jersey

Sewaren Waterfront Park

Woodbridge, New Jersey

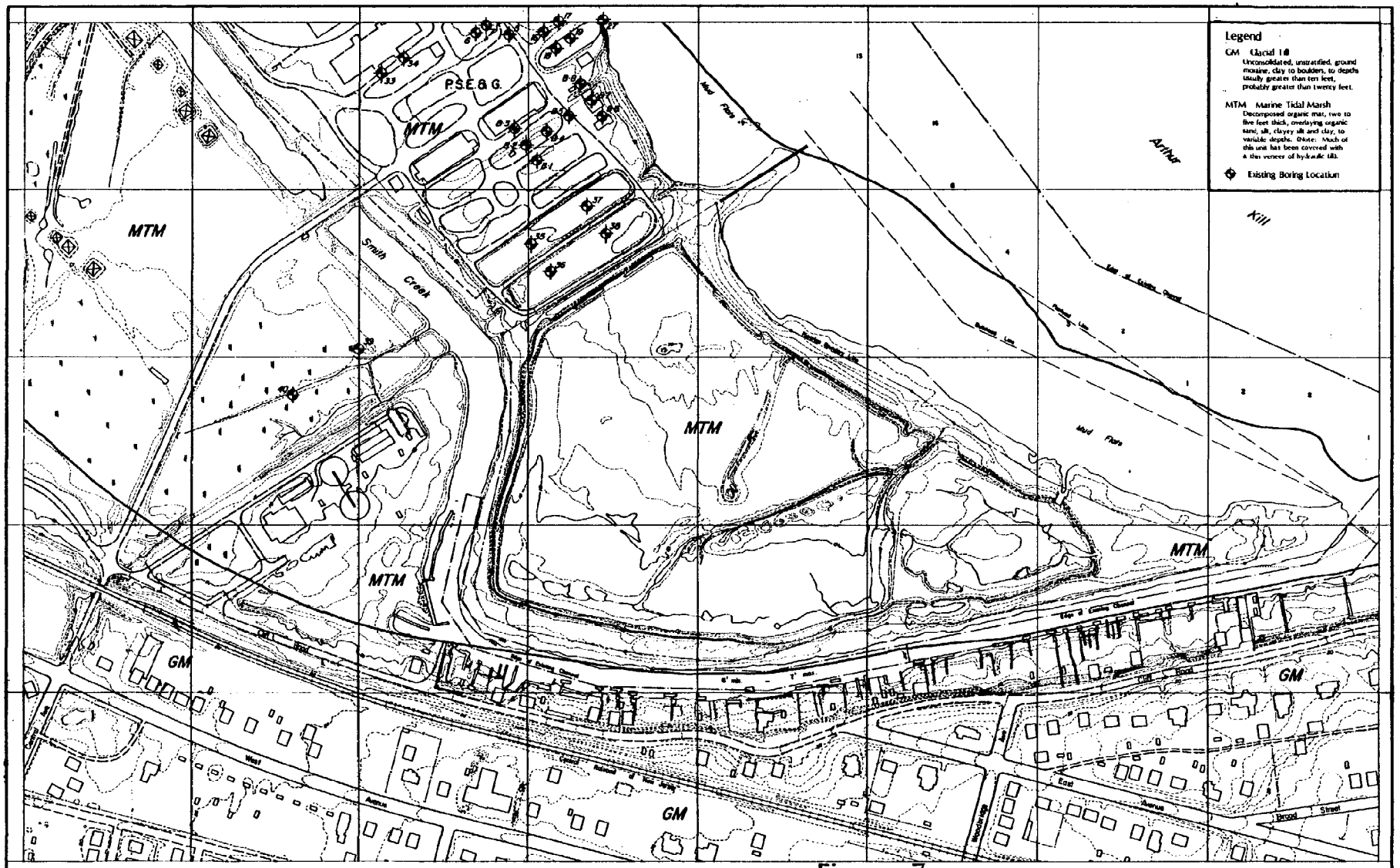
Figure 6
Topography
Contour Intervals 2 Feet

North

0 100 200 feet

Source: Aero Service Corporation, Philadelphia, Pennsylvania, March 1962

SA No. 0278



Sasaki Associates, Inc.
Watertown, Massachusetts

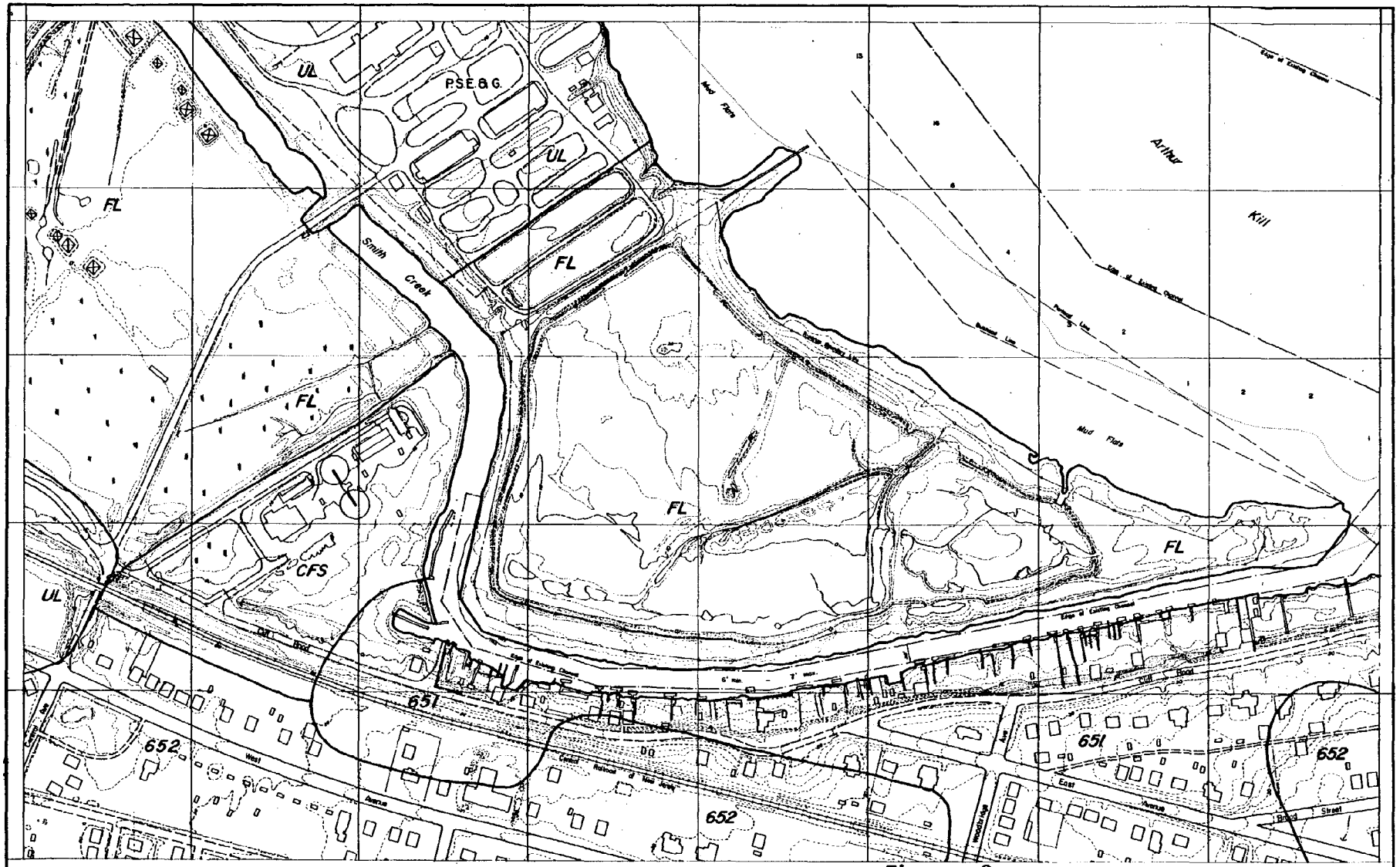
Cross Group, Inc.
Matawan, New Jersey

Sewaren Waterfront Park
Woodbridge, New Jersey

Figure 7
Surficial Geology

Source: Surficial Geology from Engineering Soil Survey of New Jersey, Middlesex County, Rutgers University, 1953
Existing Boring locations at Sewaren Generating Station by Sprague & Henwood,Inc, 1970, and Johnson Soils Engineering Company, 1978.

SA No. 0278



Sasaki Associates, Inc.
Watertown, Massachusetts

Cross Group, Inc.
Matawan, New Jersey

Sewaren Waterfront Park
Woodbridge, New Jersey

Figure 8
Soils

Legend:
- R — Filled Land, over Tidal Marsh
- UL — Urban Land, 80% Developed, on Fill over Tidal Marsh
- CFS — Cut and fill Land, Old Sand Pits
- 651 — Boonton - Urban Land Complex, Disturbed Land
- 652 — Haledon - Urban Land Complex, Disturbed Land

North

0 100 200 feet

Source: U.S. Dept. of Agriculture, Soil Conservation Service, Interim Soil Survey of Middlesex County, June 1981

SA No. 0278

Subsurface data were available from two sources. Borings B1 through B8 were conducted by Johnson Soils Engineering Company in 1978 for a proposed Maintenance Shop at the Sewaren Generating Station, and Boring Numbers 5-7, 16 - 19, 27, and 33 - 40 were conducted by Sprague and Henwood in 1970 for Sewaren Generating Station Units Nos. 7 and 8 and a proposed new oil tank. Included with the attached boring log data (Appendix II) is a copy of the geotechnical report prepared by Johnson Soil Engineering for the proposed Central Maintenance Shop.

This boring information is valuable to the Sewaren site in that it provides a general description of the subsurface soils, including stratificaton of the deposits, lateral consistency, penetration resistence and strength characteristics. Most importantly, the data allows the Sasaki Associates' team to flag certain characteristics of the soils which may offer constraints to site development. Certain constraints may result in added construction costs and may require more elaborate designs. Of particular interest in coastal regions are settlement potential and bearing capacity of the soils. The existing boring data also aids in designing a boring program if specific data are lacking or problem areas need further evaluation. However, in no case does subsurface data obtained from areas off the site preclude the need for adequate, site-specific, subsurface investigation.

A review of soil and geological data from the area suggests that the subsurface conditions at the site and in the area northeast of the site, for which existing boring data is available, are similar. Therefore, the available subsurface boring data is appropriate for estimating general characteristics at the Sewaren site.

The results of the subsurface borings indicate that the area is underlain by 3 distinct strata, defined as follows:

STRATA	RANGE IN THICKNESS
Fill (1)	10-15 feet
Organic Silt (2)	10-15 feet
Sandy Gravel (3)	35-50 feet

1. Unit may contain thin layer of sand and gravel between fill and underlying unit.

2. This unit may contain some clay and peat lenses.

3. May be a thin (4-8 foot) lens of silty sand and sandy silt between the organic deposits and underlying sandy gravel. This intervening unit is not present in all the borings.

The above strata can be broadly described in the following manner:

Fill - This material consists of fly ash, sand, silt, gravel, wood, bricks, wire and other miscellaneous debris. Whether this material extends to the Sewaren site is not known. It is believed that the Sewaren site is an old hydraulic fill as evidenced by the perimeter levees constructed to contain the dredge spoil while de-watering. In this case the sand, silt, gravel component is expected to be greater. The compaction of this material is erratic and is suggested by Johnson Soil Testing as being unsuitable for bearing. Where no fill exists, the top soil layer is a loose, wet, dark, gray, sand and gravel with black river mud and organic silt along the shore.

Organic Silt - This material consists of very soft, highly compressible organic silt. It once formed the top layer of what used to be a tidal marsh. This unit occurs consistently throughout the site. For the most part, this stratum is overlain by fill and probably has undergone partial consolidation. Therefore, it is expected to exhibit a slightly higher strength than similar material with no fill overburden. However, some settlement may be expected to occur under superimposed loading.

Sandy Gravel - Underlying the organic silt is a granular deposit of sand and gravel. The compaction of this deposit varies with depth, ranging from loose at the top to compact near the base of the deposits. Penetration resistance increases from up to 10 blows per 6 inches to 40 to 60 blows per 6 inches with increased depth. A thin layer of silty sand or sandy silt lies above the granular deposits in some instances. Its strength is lower than the granular deposits.

Groundwater was encountered generally at depths varying from 8 to 11 feet below the surface. The water table fluctuates in response to the rise and fall of the tides.

2.3.3 Vegetation

There are two vegetative associations occupying the site: upland waste area vegetation and salt marsh/mud flats. The upland area, which occupies

30.46± acres of the site, is only 65% vegetated. Bare patches make up the remainder of this zone. Vegetation species in this zone are typical of those found on dredge spoil sites and other "waste areas". The dominant species are Queen Anne's lace, goldenrod, foxtail reed grass, and various grasses. A few small trees (i.e. poplars, catalpa, Tree of Heaven) also are present.

The salt marsh and mud flat areas occupy 5± acres along the intertidal zones of Smith Creek and Arthur Kill. These areas are dominated by cordgrass (Spartina alterniflora) and foxtail reed grass. The mud flats along the Arthur Kill are sparcely vegetated and contain bands of green algae. The extent and location of these vegetative associations is presented in Figure 9 and a complete listing of species is presented in Table 2.

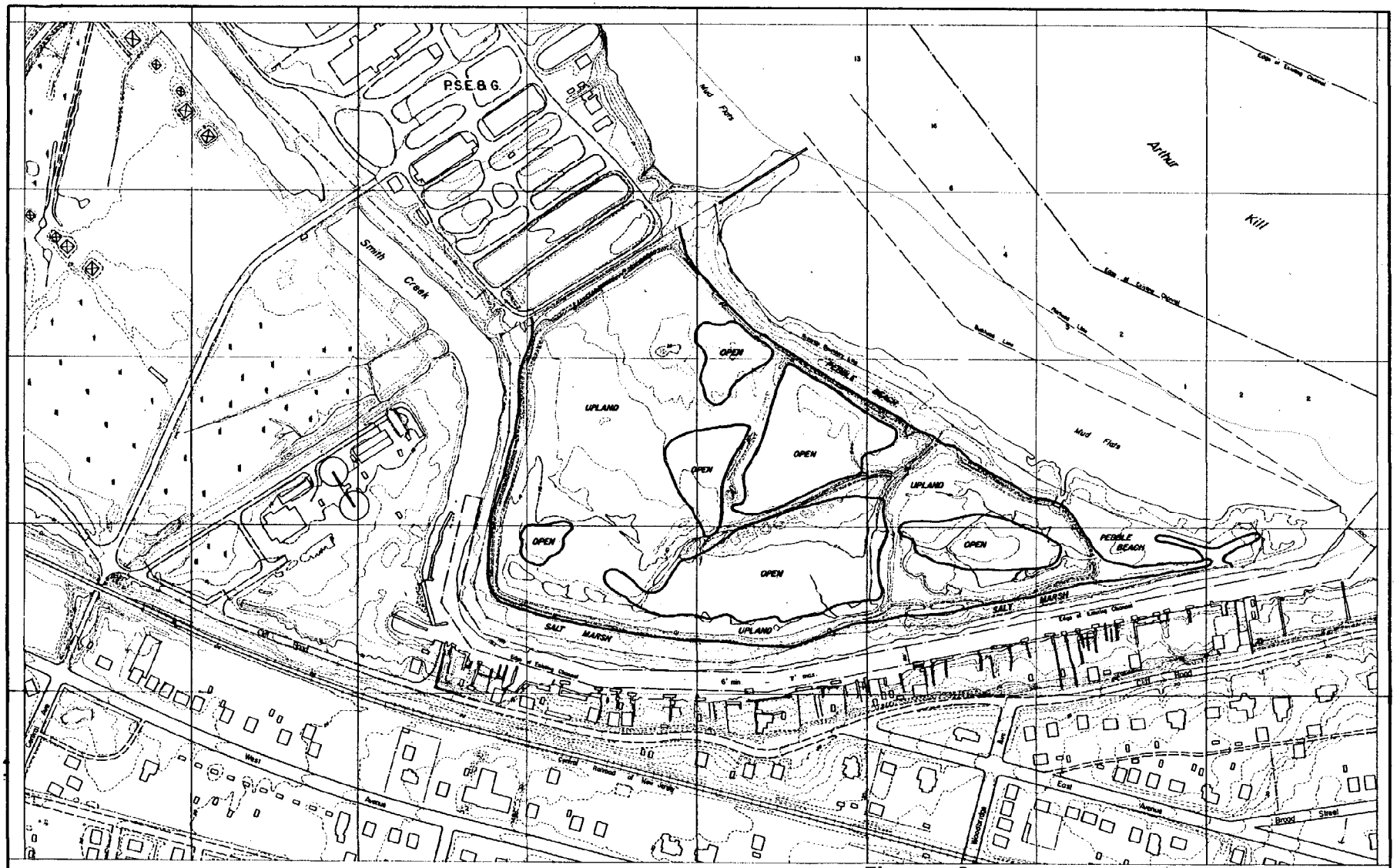
2.3.4 Wildlife and Fisheries

There are four distinct habitat types on the site: upland shrub, pebbly beach, salt marsh, and mud flats. The upland type (as described in the section entitled Vegetation) is potential habitat for a number of shorebirds (i.e. herons, gulls, common terns, etc.), songbirds, and small mammals. However, due to the lack of vegetation over a substantial portion of this area (35%), its value is limited for most of these species.

The pebbly beach area also is of potential value to shorebirds, particularly common terns. Although no published evidence exists of tern nesting at this site, it is potential habitat.

The salt marshes and mud flats are valuable habitat for several species of waterfowl, shellfish, and small mammals. Shellfish in these areas include mussels, clams and oysters. However, due to contamination, these are of no direct economic value.

The Sewaren peninsula is within the potential habitat range of three threatened or endangered fish species: shortnose sturgeon (Federal and State endangered), Atlantic sturgeon (State threatened), and Atlantic tomcod (State threatened). Both sturgeons are anadromous fish (spawn in fresh water but spend the remainder of the life cycle in salt water), but the tomcod is an inshore species (lives in stream mouths, estuaries and harbors). The actual presence of these species in the immediate vicinity of Sewaren peninsula has not been recorded.



Sasaki Associates, Inc.
Watertown, Massachusetts

Cross Group, Inc.
Matawan, New Jersey

Sewaren Waterfront Park

Woodbridge, New Jersey

Figure 9
Vegetation

SA No. 0278

TABLE 2

SEWAREN PENINSULA VEGETATION

Upland

Queen Anne's Lace	*Daucus carota*
Goldenrod	*Solidago* sp.
Quaking Aspen	*Populus tremuloides*
Tree of Heaven	*Ailanthus altissima*
Silver Maple	*Acer saccharinum*
Catalpa	*Catalpa speciosa*
Grasses	Gramineae
Foxtail Reedgrass	*Phragmites communis*

Marsh

Foxtail Reedgrass	*Phragmites communis*
Saltwater Cordgrass	*Spartina alterniflora*
Green Alga	*Enteromorpha* sp.
Marsh Elder	*Iva fructescens*

2.3.5 Meteorology

Prevailing winds are west southwest during the period May to December, northwest during February to April, and northeast during January. Wind speeds average 8 to 9 mph in the summer and 10 to 11 mph during the other months. The fastest wind speed on record occurred in November 1950 and reached 82 mph from the southwest.

Nearly all the damaging storm winds occurring in the area result from "northeasters". These are low pressure cells that generally develop off the east coast of the United States between New Jersey and Cape Hatteras, intensify, and move northeast along the coast to New England and the Canadian Maritimes.

These storms are responsible for the major episodes of precipitation. Low pressure systems passing east of the area produce the characteristic northeast winds. The maximum recorded northeast wind speed was 52 mph in January 1964. Storms which pass west of the area create southeasterly winds. The "Northeasters" produce a considerable portion of the annual precipitation and are most common during the fall and winter. They generally last for 48 hours and produce between one and two inches of precipitation. Storms producing four inches or more of snow occur, on the average, twice a year. The maximum frequency is five per year. Storms producing eight or more inches of snowfall occur, on the average, once every two years with a maximum of three per year.

Northwest winds can achieve high velocities following the passage of cold fronts. These winds tend to last for a short period of time. Winds also will back around to the northwest after the passage of coastal, low pressure systems. These winds may be continuous for up to 24 hours.

Southwest summer winds are generated by extensive, upper level, high pressure cells which commonly stall over the Bermuda area. Under these conditions, warm muggy air is pumped continuously into the area until the system moves or is dissipated.

The source of the above meterological information is: National Oceanic and Atmospheric Administration (1980), Local climatological data, annual summary with comparitive data, 1980, Newark, New Jersey.

2.3.6 Marine Characteristics

Tides

According to the U.S. Army Corps of Engineers, mean tide range is about 5.1 feet with a mean spring tide range of 6.1 feet. Tidal elevations are summarized as follows:

Mean High Water	+ 3.15 ft.	
Mean Low Water	- 1.95 ft.	
Extreme High Water	+10.05	(9/12/60)
Extreme Low Water	- 5.55 ft.	(3/27/55)

Tidal means are based on a 21-year record, extending from 1938 to 1953.

All of the above elevations are given in feet above or below the National Geodetic Vertical Datum (NGVD) (formerly mean sea level of 1929). This reference plane is a standardized datum utilized in most surveys. Some confusion may result depending on the kind of survey work requested. Land surveys commonly use NGVD. However, water surveys, utilized for dredging documents, give elevations which are referenced to a mean low water datum (mlw). For this study the difference between NGVD and mlw is 1.95 feet (mlw datum is 1.95 feet below NGVD).

Flooding

Regarding flooding frequency and flood elevations, the U.S. Army Corps of Engineers supplied the following information:

Storm Frequency Event	Flood Elevation (NGVD)
10 - year	8.6'
25 - year	9.3'
50 - year	10.0'
100 - year	10.5 to 11.5'

Some variability exists in the 100-year flood elevation. This variation results from the method used to plot the upper limits of the frequency curve.

Recent analyses, conducted for the U.S. Department of Housing and Urban Development by Dewberry and Davis in Fairfax, VA, indicate different flood elevations. Their study utilized the National Academy of Science's wave height and storm surge analysis. The study was recently completed for Woodbridge and gave the following results:

Storm Frequency	Flood Elevation (Static Only)
10	+ 7.4' (NGVD)
50	+10.0'
100	+12.0'
500	+15.0'

These elevations were obtained from a tide gauge analysis at Perth Amboy and Sandy Hook. The original analysis was completed by Richard Brown Associates for the N. J. Department of Environmental Protection. The southern and eastern portions of the site have been designated V12-zones. A V-zone is defined as that portion of the 100-year coastal flood zone which is subjected to the breaking of 3-foot waves and the resulting dynamic forces. The V12-zone is the V-zone in areas where the base flood elevation is +12 feet (NGVD).

From the southern tip of the site to a point about 750+ feet north along the Arthur Kill the actual 100-year flood elevation (base flood elevation plus anticipated wave height and runup) is +15 feet (NGVD). North of this point the flood elevation is +12 feet (NGVD). However, the +15-foot (NGVD) flood elevation is applicable only under existing grade conditions. Under the proposed Master Plan, the elevation of the peninsula will be increased to +12 feet (NGVD), and the shoreline grade will be adjusted to 3:1. Due to the changes in elevation and grade, 3-foot waves will break further offshore from the new berm crest; thus, reducing damages to the peninsula.

Currents

Maximum current velocities in the Arthur Kill from Outerbridge to Port Reading (reaches adjacent to site) is 1.5 or 1.7 knots (flood and ebb tide, respectively). No current data is available for Smith Creek but velocities are not expected to exceed those in Arthur Kill.

Bathymetry

There are two navigational channels which pass by the site. The primary channel follows the Arthur Kill and carries a substantial portion of commercial vessels. This channel is maintained by the U.S. Army Corps of Engineers, and depths range from 32 to 35 feet below mean low water. A channel also is provided for small boat navigation on Smith Creek. This channel is 50 feet wide and is maintained by the State of New Jersey. Present channel depths vary between 4 and 5 feet below mean low water. All other areas adjacent to the site and not part of an existing channel consist of mud flats or shallows with depths ranging from less than 1 to 16 feet below mean low water. These areas generally are not subject to navigation.

Dredging and Siltation

There are no sediment budget computations available from the U.S. Army Corps of Engineers for this segment of the coast. However, based on discussions with U.S. Army Corps of Engineers personnel, the frequency of dredging in the Arthur Kill is low. The last time the Outerbridge - Port Secony Reach was dredged was in 1972. It is not likely that this reach will be dredged in the next five years. The Port Reading Reach (north of the site) was dredged in 1962. Based on this analysis, the siltation rate is not excessive and dredging frequency is on the order of once every 10 to 20 years.

Discussions with John Garofalo of the New Jersey Bureau of Coastal Engineering indicated that the dredging frequency in Smith Creek is very low. At the time of this writing, the last available record of dredging was 1938.

Erosion/Accretion Regime

The area appears to be accreting slowly. The east shore of the site appears to be transgressing toward the navigation channel as evidenced by new growth of marsh vegetation. Localized areas of erosion are evident along Smith Creek. Vertical faces of marsh are slumping away and being deposited in Smith Creek. The landside portion of the site appears to be relatively stable.

2.3.7 Utilities

At present, no utilities exist on the site. Contacts with the Woodbridge Engineering Department indicated that a sanitary sewer is available for tie-in at Cliff Road. The existing sewage treatment plant, located north of the site, will receive the wastes from the park. Long-range plans call for the abandonment of this treatment plant and replacement with a pump station. This improvement program is contingent upon the availability of funds. In either case, there will be adequate capacity to allow a tie-in from the park. Such a tie-in will require the following:

6" sewer (1800 linear feet)
3" twin force mains (1100 linear feet)
pump station (1)
manholes (6)

According to the Middlesex Water Company, adequate water supply is available for the park site. A 20-inch water main exists in Central Avenue and a 6-inch main is located in Cliff Road as far as the Sewage Treatment Plant. Connection to the water supply will require the installation of 1600 feet of 8-inch pipe and appurtenant services.

No storm drainage exists on the site. A drainage system will be designed and installed as necessary.

2.3.8 Special Areas

The New Jersey Department of Environmental Protection, in an effort to increase the predictability of the Department's coastal decision-making process and ensure the enforceability of the coastal management program, published Coastal Resource and Development Policies (N.J.A.C. 7:7E - 1.1 et seq.). In defining its policies, the Department designated 44 different coastal areas (resources) which merit focused attention and special management policies. The areas are referred to as "Special Areas" and include water areas, water edge areas, and land areas.

The Sewaren peninsula site and immediate surroundings contain seven of these "Special Areas", which are defined as follows:

1.) Filled Water's Edge - Filled Water's Edge areas are existing filled areas lying between Wetlands or Water Areas, and either: (1) the upland limit of fill, or (2) the first public road or railroad landward of the adjacent Water Area, whichever is closer to the water. Some existing or former dredge spoil and excavation fill areas are Filled Water's Edge Area.

Policy - Water dependent uses are acceptable in the Filled Water's Edge. Non-water dependent development in the Filled Water's Edge is conditionally acceptable provided (a) it would not preempt use of the waterfront portion of the Filled Water's Edge for potential water dependent uses, and (b) it would not prevent public access along the water's edge.

2.) Navigation Channels - Navigation channels include water areas in tidal rivers and bays presently maintained by DEP or the Army Corps of Engineers and marked by U.S. Coast Guard with buoys or stakes, as shown on NOAA/National Ocean Survey Charts: 12214, 12304, 12311, 12312, 12313, 12314, 12316, 12317, 12318, 12323, 12324, 12326, 12327, 12328, 12330, 12331, 12332, 12333, 12334,12335, 12337, 12341, 12343, 12345, 12346, and 12363. Navigation channels also include channels marked with buoys, dolphins, and stakes, and maintained by the State of New Jersey, and access channels and anchorages. Navigation channels are approximately parallel to the river bed. Access channels are spurs

that connect a main navigation channel to a terminal. Anchorages are locations where vessels moor within water at or near the water's edge for the purpose of transferring cargo, or awaiting high tide, better weather, or fuel and terminal availability.

Policy - New or maintenance dredging of existing navigation channels, is conditionally acceptable providing that the condition under the new or maintenance dredging policy is met. Development which would cause terrestrial soil and shoreline erosion and siltation in navigation channels shall utilize appropriate mitigation measures. Development which would result in loss of navigability is prohibited.

3.) Marina Moorings - Marina moorings are areas of water that provide mooring and boat maneuvering room as well as access to land and navigational channels for recreational boats. Typically, maintenance dredging is required to preserve water depth.

Policy - Any use that would detract from existing or proposed recreational boating use in marina mooring is discouraged. Maintenance dredging in the marina mooring and access channel is encouraged provided that turbidity is controlled and that there is an acceptable dredge spoil disposal site.

4.) Submerged Infrastructure Routes - A submerged infrastructure route is the corridor in which a pipe or cable runs on or below a submerged land surface.

Policy - Any activity which would increase the likelihood of infrastructure damage or breakage, or interfere with maintenance operations is prohibited.

5.) Intertidal Flats - Intertidal Flats are extensive areas between the mean high water line and mean low water line along tidal bayshores. Intertidal flats are found along Delaware Bay in Cape May County and in other tidal bayshores.

Policy - Development, filling, new dredging or other disturbance of intertidal flats is discouraged. Submerged infrastructure is conditionally acceptable, provided that (i) there is no feasible alternative route that would not disturb intertidal flats, (ii) the infrastructure is buried deeply enough to avoid exposure or hazard, and (iii) all trenches are backfilled with naturally occurring sediment.

6.) Beaches - Beaches are gently sloping unvegetated areas of sand or other unconsolidated material that extend landward from the mean high water line to either: (1) the vegetation line, (2) a man-made feature generally parallel to the ocean, inlet, or bay waters such as a retaining structure, seawall, bulkhead, road or boardwalk, except that sandy areas that extend fully under and landward of an elevated boardwalk are considered to be beach areas, or (3) the seaward or bayward foot of dunes, whichever is closest to the bay, inlet or ocean waters.

Policy - Development is prohibited on beaches, except for development that has no prudent or feasible alternative in an area other than a beach, and that will not cause significant adverse long-term impacts on the natural functioning of the beach and dune system, either individually or in combination with other existing or proposed structures, land disturbances or activities. Examples of acceptable activities are:

(i) Demolition and removal of paving and structures,

(ii) Dune creation and related sand fending and planting of vegetation for dune stabilization,

(iii) The reconstruction of existing amusement and fishing piers and boardwalks,

(iv) Temporary recreation structures for public safety such as first aid and lifeguard stations,

(v) Shore Protection Structures which meet the Use conditions of Section 7:7E-7.11(e), and

(vi) Linear development which meets the Policy on Location of Linear Development (7:7E-6.1).

Public access to beaches is encouraged. Coastal development that unreasonably restricts public access to beach is prohibited.

7.) Wetlands - Wetlands are areas where the substrate is inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegegation typically adapted for life in saturated soil conditions which are subject to the Wetlands Act, or the Coastal Area Facility Review Act (CAFRA) or the Waterfront Development Law. Wetlands regulated under the Wetlands Act of 1970 are delineated at a scale of 1:2,400 on official maps as listed at N.J.A.C. 7:7-1.13. All coastal wetlands situated in the Raritan Basin, south along the Atlantic Ocean and north along Delaware Bay and River are subject to the Wetlands Act.

The Waterfront Development Law regulates all wetlands north of the Raritan Basin, except for areas within the Hackensack Meadowlands District not now or formerly flowed by the tides, and all coastal wetlands in the Delaware River Basin and Raritan River Basin not regulated under the Wetlands Act.

Policy - In general, development of all kinds is prohibited in wetlands, unless DEP can find that the proposed development meets the following four conditions.

(i) Requires water access or is water oriented as a central purpose of the basic function of the activity (this policy applies only to development proposed on or adjacent to waterways),

(ii) Has no prudent or feasible alternative on a non-wetland site,

(iii) Will result in minimum feasible alternation or impairment of natural tidal circulation (or natural circulation in the case of non-tidal wetlands), and

(iv) Will result in minimum feasible alteration or impairment of natural contour or the natural vegetation of the welands.

In particular, dumping solid or liquid wastes and applying or storing certain pesticides on wetlands are prohibited.

Both the restoration of degraded wetlands as a mitigation measure for certain types of approved wetlands development and the creation of new wetlands in non-sensitive areas are encouraged. The Division of Coastal Resources previously has required restoration of temporarily disturbed wetlands and will continue to do so on a case-by-case basis.

Under the Wetlands Act, the activities of DEP, the Tidelands Resource Council, the State Mosquito Control Commission and county mosquito control commissions are exempted from the coastal wetlands policies within mapped coastal wetlands. Voluntary administrative compliance with the regulations adopted by DEP under the Act is not, however, precluded.

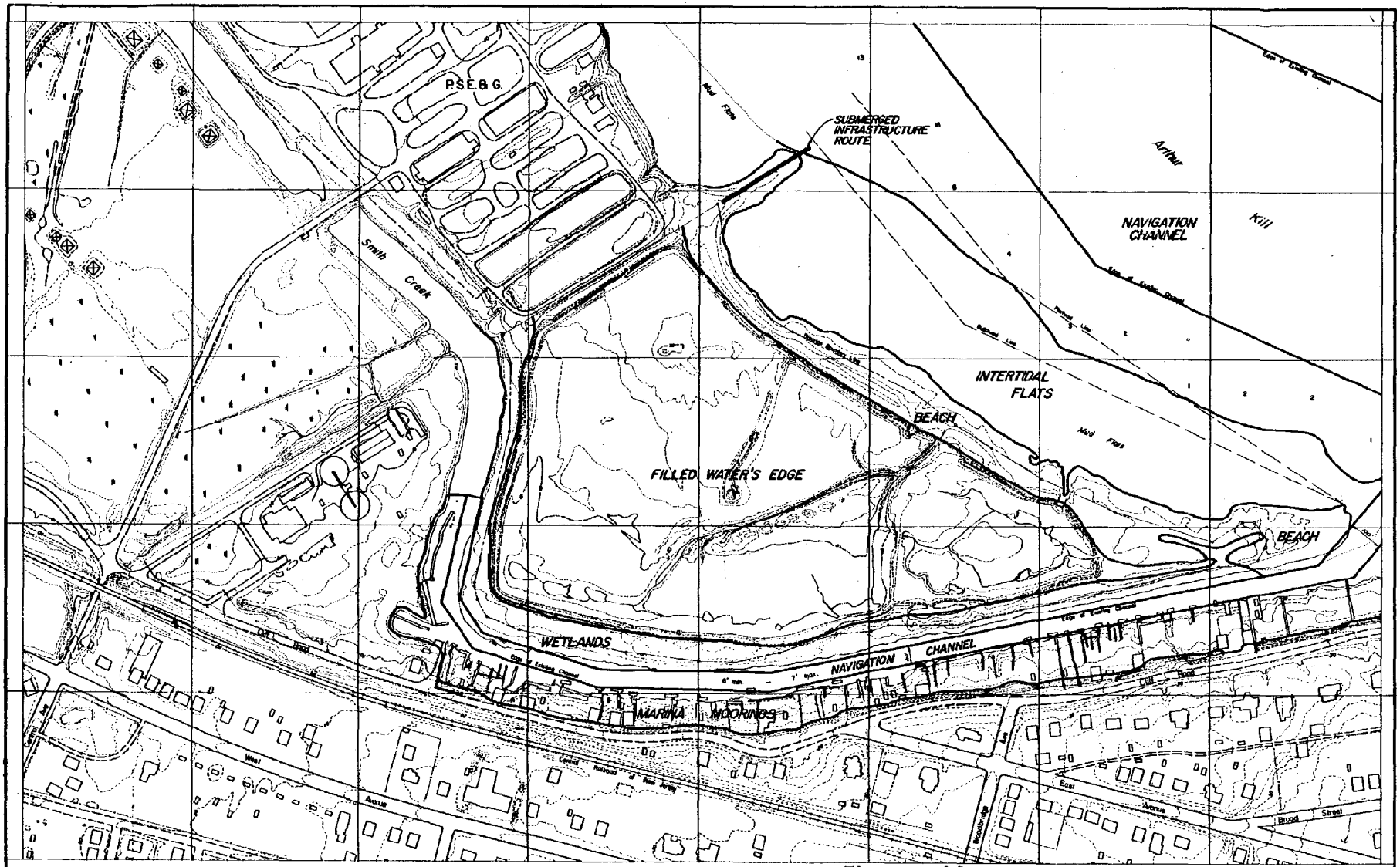
The location and extent of these seven "Special Areas" is presented in Figure 10.

3.0 ENGINEERING ANALYSIS

3.1 Foundation Analysis

Two issues of concern are raised by the available subsurface data, (see Geology & Soils Section 2.3.2) settlement and slope stability. A stratum of saturated soil, which is of a compressible nature (such as the existing organic silt), will compress only when the load or weight of material above the soil stratum is increased. The resulting compression (change in volume) of the soil, due to this increase in load, is directly related to the volume of water forced out of the saturated soil, and is commonly referred to as consolidation. As the soil consolidates, the thickness of the compressible stratum decreases and the ground surface over the area undergoes settlement. In the case of heavy and/or rigid structures this settlement cannot be tolerated.

A second consideration is slope stability. The organic silt which lies below the surface soil is not only compressible but also has low bearing capacity. It is an incompetent unit. Loading this incompetent layer at the surface, whether with a building or by filling to raise the site's elevation, increases the stresses within the unit. As a result, water pressure in the voids of the soil will become excessive. In cases where excavations are considered in the design (such as the excavation of a harbor as proposed in this plan), removal of the soil adjacent to such structures or fill zones decreases the lateral support provided to the incompetent bed. In such cases, sloughing, slumping and other slope failures may result.



Sasaki Associates, Inc.
Watertown, Massachusetts

Cross Group, Inc.
Matawan, New Jersey

Sewaren Waterfront Park

Woodbridge, New Jersey

Figure 10
Special Areas

North

0 100 200 feet.

Source: Special Areas as defined in the New Jersey Coastal Management Program, August 1980.

SA No. 0278

One advantage this site offers, however, is that the existing fill overlying the organic deposits has been in place for several years. This probably has allowed the organic deposits to consolidate partially. With such partial consolidation, bearing strength of the underlying soils has been gained.

The preliminary Master Plan for the waterfront park will contain the following non-marine related, structural elements which influence soil bearing capacity:

1. A restaurant facility and Harbor Master headquarters building.

2. An observation tower.

3. A double-lane boat launching ramp.

4. General filling of the site by 4 to 6 feet to raise the grade.

Much of the area requiring fill will be open space with no rigid structures and will be unaffected by minor settlements. Parking lots, on the other hand, may experience some settlements creating small depressions and "bird-baths".

Based on the design elements of the park and foregoing soil discussion, the following recommendations are suggested for foundation design.

1. All buildings (harbor master building, restaurant, observation tower) and ornamental structures (fountains, etc.) may require pile supported foundations to eliminate excessive settlements.

2. Based on available information, should piles be needed, they may extend 40 to 45 feet below the surface. Concrete and/or timber piles are suggested if cost-competitive.

3. Use soft surfaces (grass, landscaping, etc.) in fill areas to reduce maintenance costs that result from settlement damage. Minimize hard surfaces. Delay paving parking areas to allow post-construction settlements to progress.

4. Provide graded edges to the shore to reduce both settlement and slope failure potential. Keep final elevations as close to existing grade as possible to reduce excessive settlements.

5. Use placed rip rap on slopes within the boat basin. This is the most cost effective design solution and allows the slope structure to be somewhat flexible in the event of differential settlement. Rip rap size should be designed to only that size necessary to protect against the wave energy anticipated and no larger. This will decrease loads on the slope.

6. Avoid filling adjacent to the harbor excavation. Keep post-construction loads at the head of slopes near pre-construction levels. This will reduce the potential of slope failure.

7. Keep cut and fill slopes to 3:1 (horizontal to vertical) or flatter.

8. Make use of lightweight fill if available to decrease total loads.

9. Conduct a preliminary "reconnaissance level" subsurface boring program on the site. This may result in modifications of the above recommendations.

All recommendations are based on data obtained from borings located off the site and from professional experience in similar types of environments. However, in order to make a complete and effective evaluation of foundation alternatives, it is imperative that a preliminary boring program be initiated on the site.

For this evaluation, it is important to determine both the consolidation characteristics and strength properties of the underlying soils. A proposed boring program is described in Appendix III.

Most of the buildings proposed in the Master Plan are light structures. Depending on the type and extent of subsurface soils found at the building sites, the following foundation alternatives are possible:

1. Conventional spread footings;

2. Floating mat foundation (weight of soil excavated beneath the building equals the weight of the building);

3. Pile supported foundations.

The cost of these alternatives increases from least to most expensive in the order presented. Alternative 2 requires greater design finesse and depends somewhat on

building design. It is premature to select a recommended foundation system prior to review of on-site subsurface data; however, conventional spread footings, which are expected to be feasible, probably are most desirable.

3.2 Marine Analysis

3.2.1 Design Criteria

Wave Height

The site is exposed to waves from two directions on the Arthur Kill: east northeast and south southeast. These wind directions do not coincide with prevailing wind directions (northeast and south southwest) but are associated with storm activity. Maximum wind speed recorded from the northeast is 52 mph and a 55 mph wind is assumed from the south southeast. The wave height generated by wind is not only a function of the wind speed but also depends on fetch and water depth. Using a hindcasting technique developed by the U.S. Army Corps of Engineers, the following design wave heights have been established for the eastern shore of the site.

Direction	Wave Height (ft)	Wave Period (sec)
SSE	2.5	3.0
NE	2.2	2.75

Refraction, diffraction and shoaling may either increase or decrease the height of approaching waves before they begin to break. The curved shoreline in relation to the wave trains approaching the site, and the extensive tidal flat adjacent to the site will tend to dissipate wave energy slowly and reduce the height. Therefore, the computed wave heights may be smaller. However, as a conservative approach a design wave height of 2.5 will be utilized.

Unlike the Arthur Kill, Smith Creek is protected from all directions. Wind generated wave heights are expected to be less than one foot in this area and boat generated wakes may approach one foot.

Flood Elevations

Based on existing flood elevation data, (Section 2.3.6) landside facilities should be set at elevation +12 feet (NGVD).

Marina Dimensions

Entrance channel widths for two-way traffic should be no less than 50 feet wide. Freeway clearances within the basin are computed by multiplying 1.5 times the maximum boat length for each set of slips. Minimum berth sizes are computed by using the formula: W=2(bw)+3' in between +2'(one foot on either side), where W is the width of the double berth and bw is the boat beam; an extra five feet is added for between boat and between dock clearance. Walkway dimensions are 8 feet wide or more, and finger piers are no less than 3 to 4 feet wide.

Depths

Based on a minimum channel width of 50 feet, the maximum craft length recommended for safe navigation is 40 feet. Therefore, the minimum dredge depth recommended is -8 feet mean low water (-9.95 NGVD).

Marina Water Surface Area

The marina concept has been designed to handle between 200 and 300 boats. Marina's below a 200 boat capacity are not economically justified, and a capacity greater than 300 boats requires the use of more land area than desired under the park program. The areal requirements for a 210 and 300 boat marina are 4.5 and 6.5 acres, respectively. These figures represent only the mooring basin and do not include freeway clearance or other space required for manueverability.

The marina will be laid out to handle a boating mix ranging from boat lengths of 20 to 40 feet. This range will provide berths for the major portion of the recreational boat market. Crafts less than 20 feet generally are "trailerable".

Facilities and Services

Administrative and supervisory facilities will be provided at a convenient location in the marina. This area will house the Dock Master, helpers and all control systems. Restaurant, chandlery, restrooms, showers and facilities containing miscellaneous supplies will be provided along the south flank of the boat basin. Parking for boat owners will be available immediately east of the marina. A fuel dock will provide diesel, gasoline, water, and ice services. Temporary dock space will be available for a maximum of five boats. In addition, pump-out facilities will be provided. Effluent from holding

tanks on boats will be pumped to the sanitary sewer or to a temporary storage tank located at a convenient point on shore. Fuel tanks will be stored adjacent to the fuel dock and the Harbor Master's building. The Harbor Master will supervise the fueling operation. Solid waste disposal facilities will be placed at a convenient location on land where pick-up services are available. Pedestrian access will be available along a promenade which will border the marina on the landward side.

A double lane boat launch will be provided for smaller crafts (less than 25 feet). A total of 60 parking spaces per lane will be available for cars and trailers. The boat launching facilities are located such that they will not interfere with marina operations.

Water, electricity and lighting will be provided for all marina facilties.

3.2.2 Marina Alternatives

Five alternatives have been examined and are presented in Figures 11 through 15. Three are located on Smith Creek and two on Arthur Kill.

Alternative I (Figure 11)

This concept consists of a series of berths located adjacent to Smith Creek. The marina is completely open to Smith Creek.

Alternative II (Figure 12)

This concept consists of an L-shaped harbor which is open to Smith Creek at the south end by a 130 foot entrance channel. Parking, restaurant and harbor master facilities are provided on a spit of land separating Smith Creek from the harbor.

Alternative III (Figure 13)

This harbor is incised into the east shore of the peninsula. A breakwater and jetty are needed to protect the harbor from waves approaching from the southeast.

Alternative IV (Figure 14)

Rather than being incised into the peninsula, this harbor lies within the Arthur Kill and follows the form of the shoreline. A fixed or floating breakwater is necessary along the north and south flanks of the harbor. The east entrance is somewhat exposed to waves approaching from the east and southeast.

Alternative V (Figure 15)

This concept is similar to Alternative II, except the 130 foot entrance channel is located in the center of the harbor.

SUMMARY

Of the five alternatives, the marina facilities located on the Arthur Kill appear to be the least desirable for the following reasons.

1. During storm conditions, 2 to 2.5 foot waves may be generated on the Arthur Kill. This will necessitate wave protection. A floating breakwater has a high annual maintenance cost; whereas, a fixed breakwater

Figure 11

PROJECT NO 0279-31 | SASAKI ASSOCIATES, INC. | SHEET NO. 12 OF
TITLE WOODBRIDGE | 64 PLEASANT STREET | DATE July 29 91
WATERTOWN, MA 02172 | BY VC CK'D

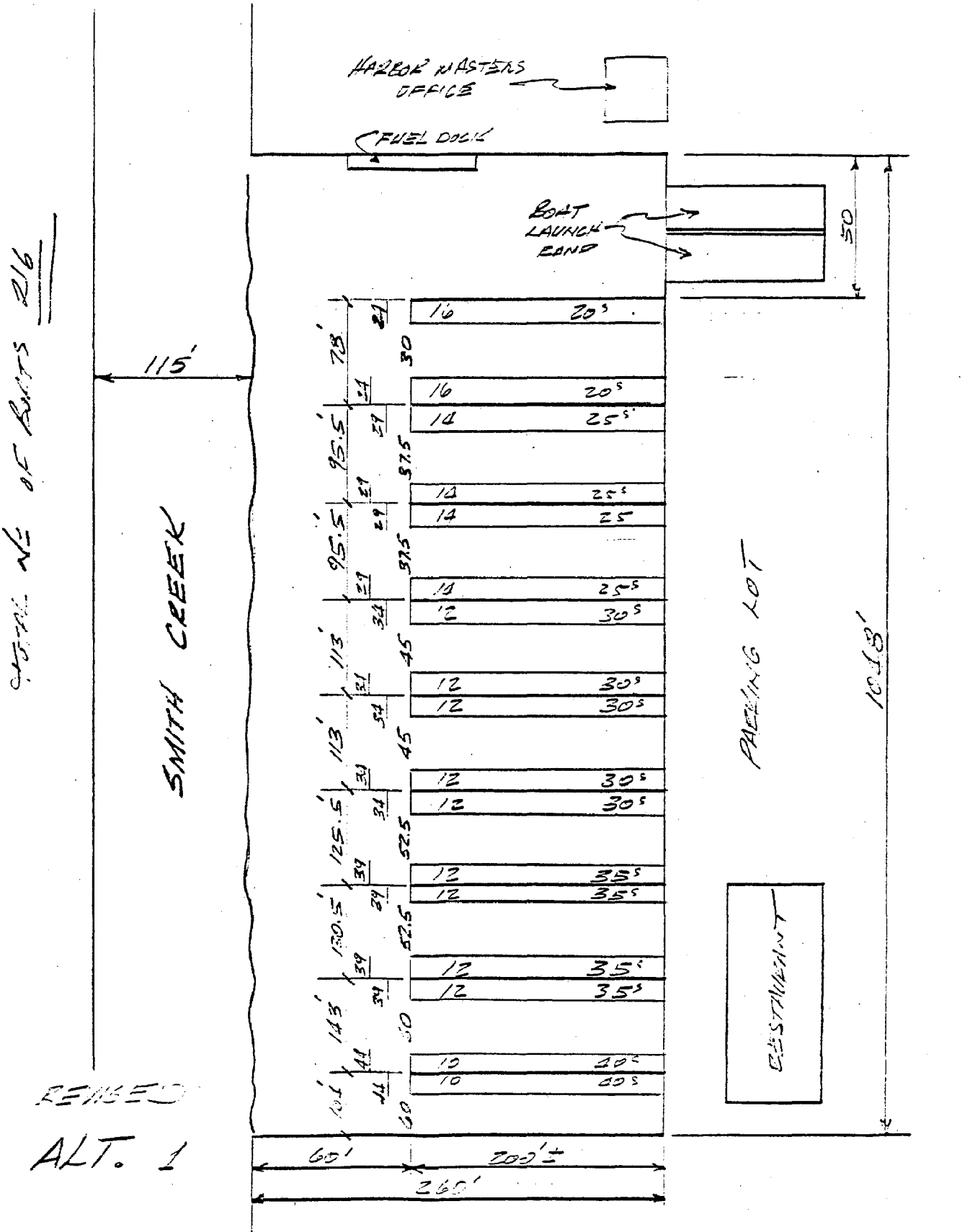


Figure 12

PROJECT NO. 0278-31 | SASAKI ASSOCIATES, INC. | SHEET NO. 13 OF ____

TITLE WOODBRIDGE | 64 PLEASANT STREET, WATERTOWN, MA 02172 | DATE July 29 81

BY VHF CK'D ____

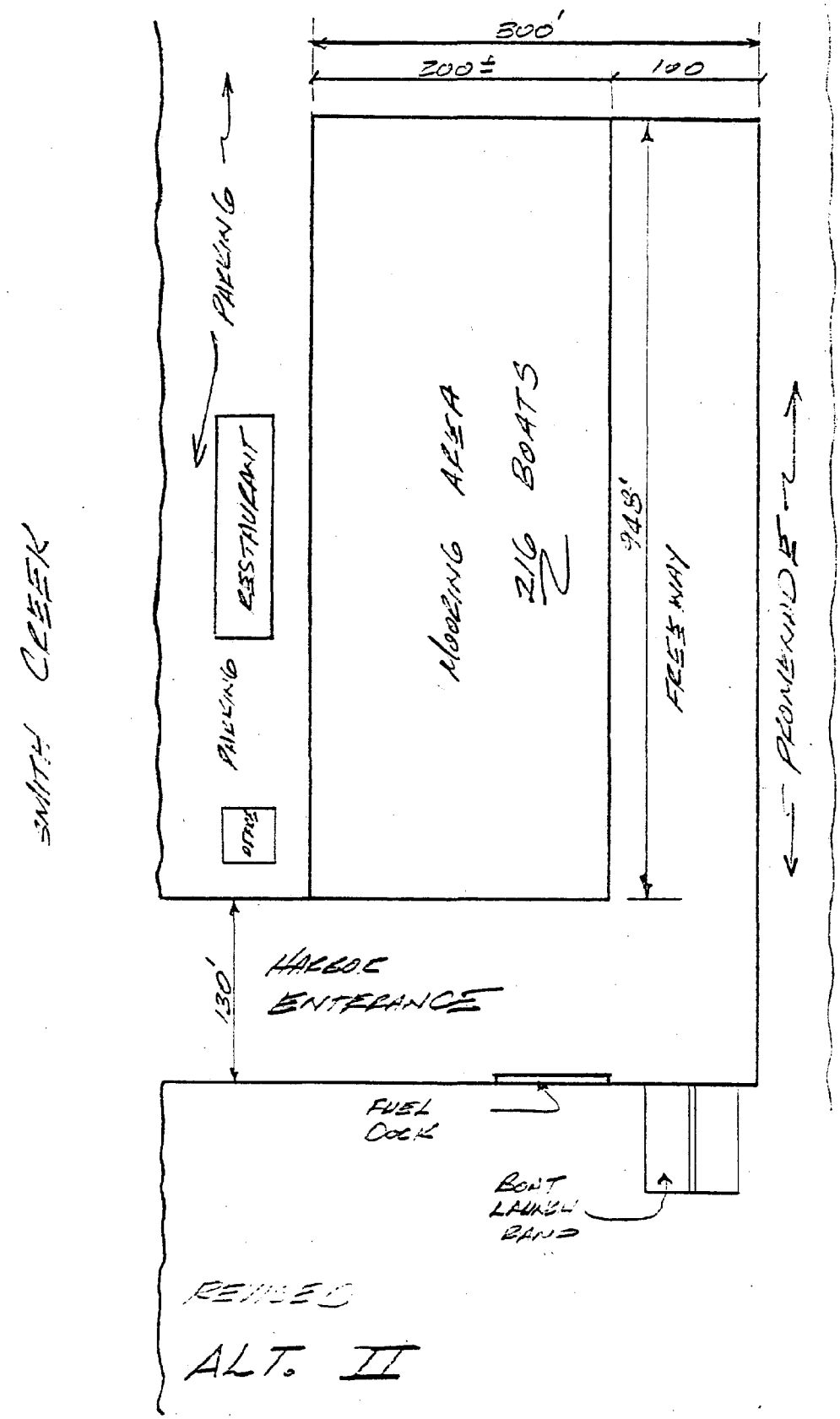
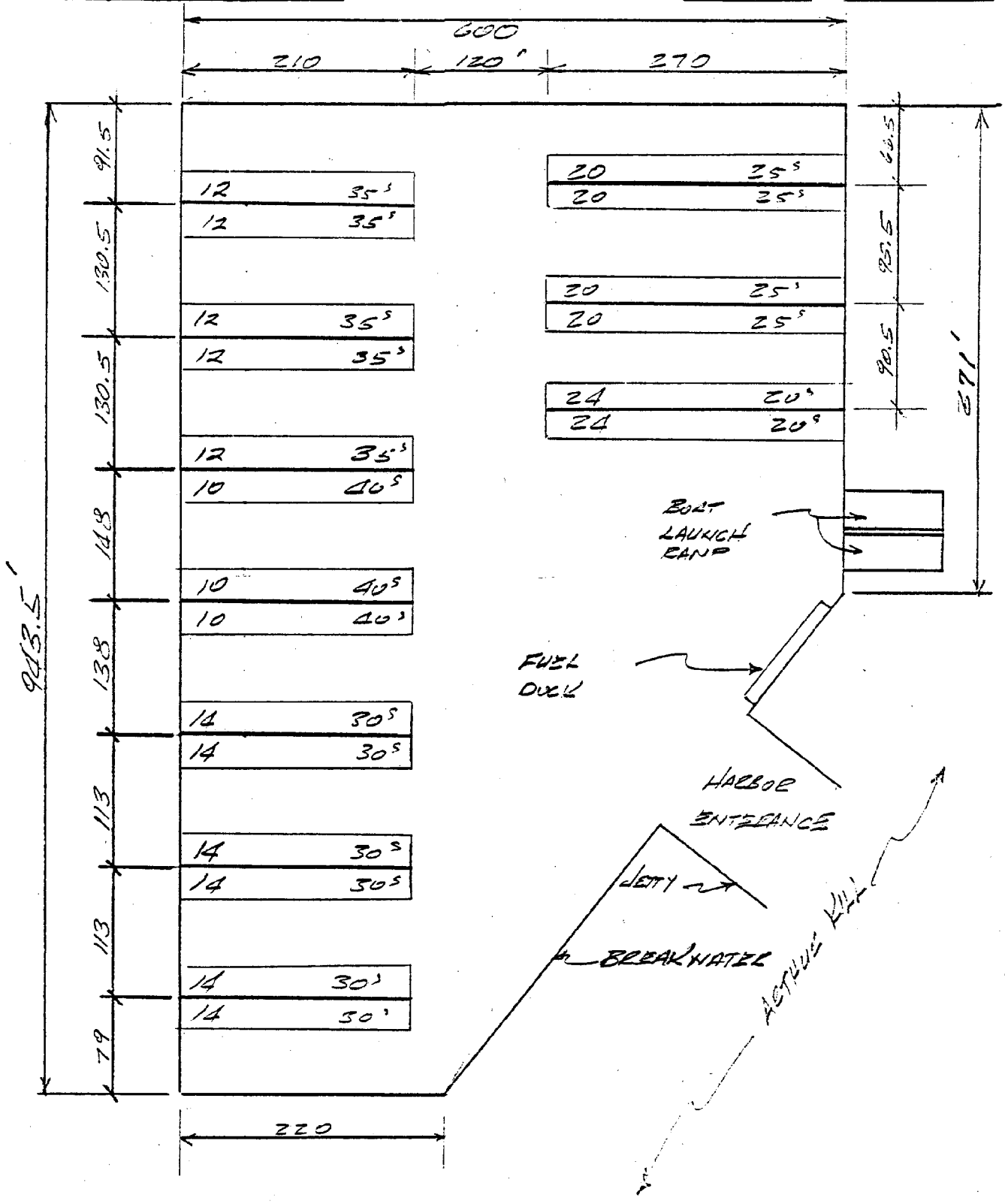


Figure 13

PROJECT NO. 0278-31 SASAKI ASSOCIATES, INC. SHEET NO. 5 OF
64 PLEASANT STREET DATE July 23 31
TITLE WOODBRIDGE WATERTOWN, MA 02172 BY WWC CK'D



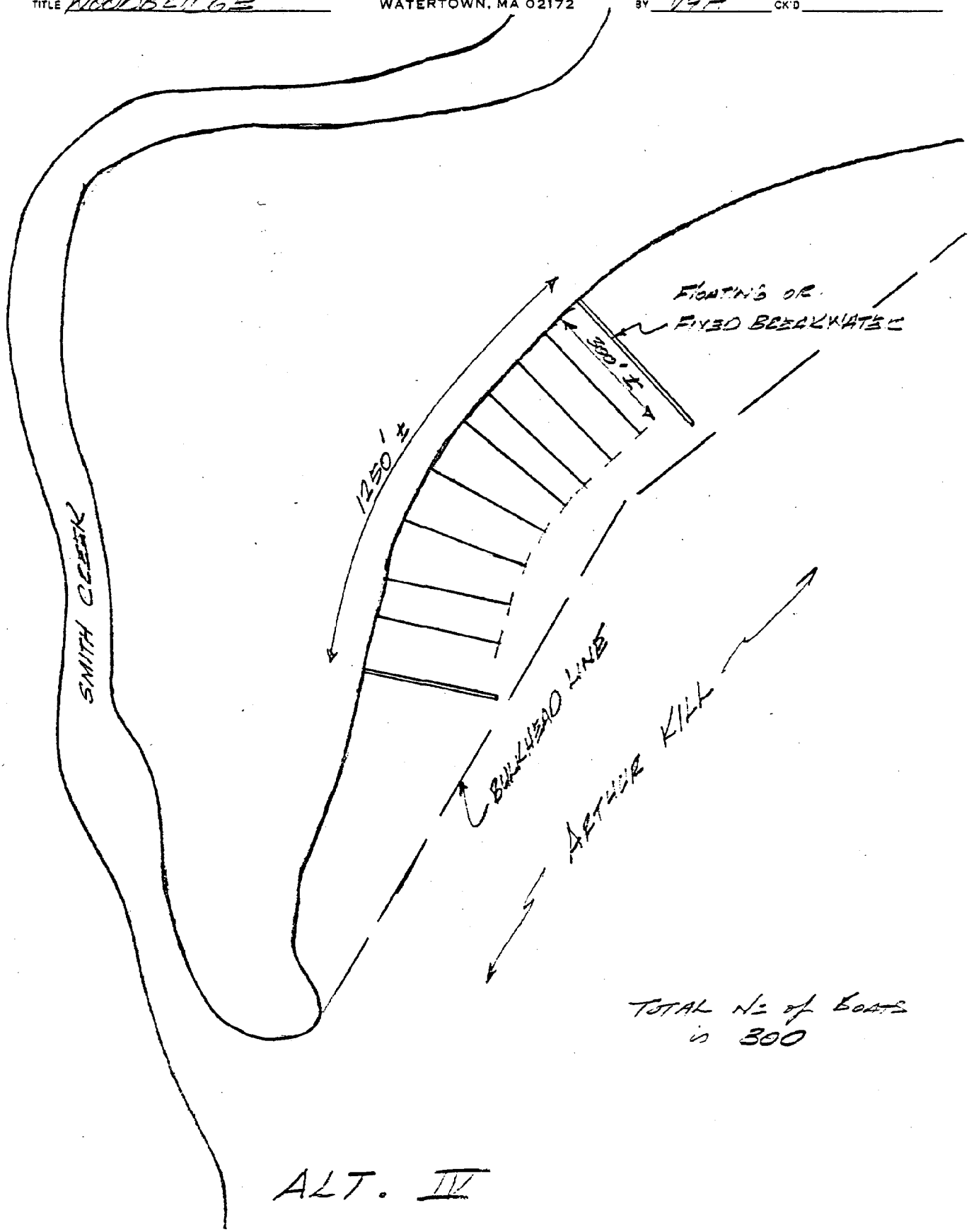
ALT. III

Figure 14

PROJECT NO. 0278-31
TITLE HOOGBEICGE

SASAKI ASSOCIATES, INC.
64 PLEASANT STREET
WATERTOWN, MA 02172

SHEET NO 8-A OF
DATE 7/24 23 91
BY VSH CK'D



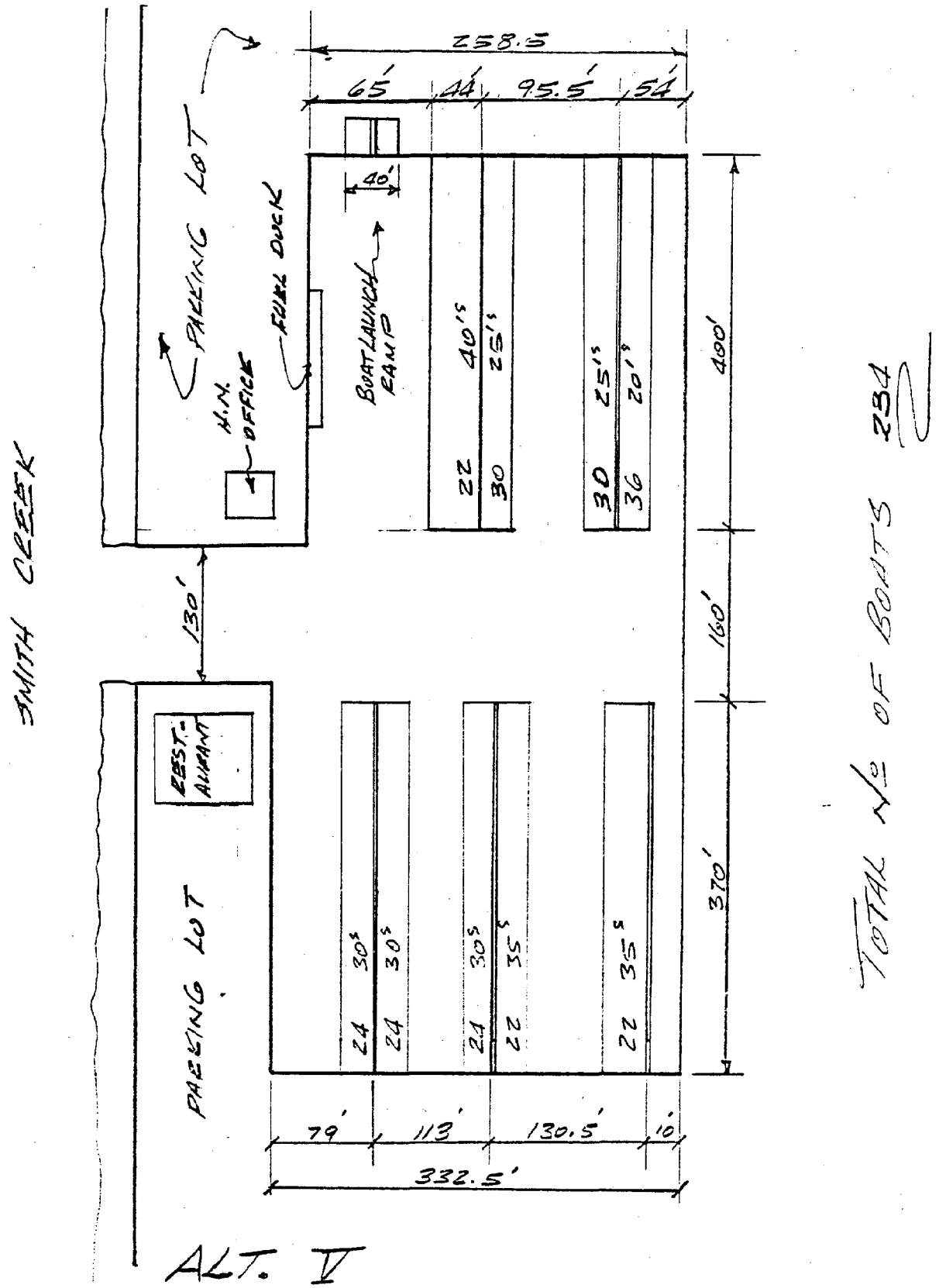
ALT. IV

Figure 15

PROJECT NO. 0278-31 | SASAKI ASSOCIATES, INC. | SHEET NO. 14 OF ____

TITLE Woodbridge | 64 PLEASANT STREET, WATERTOWN, MA 02172 | DATE Oct 29 81

BY VJF CK'D ____



has high initial cost. This cost could be even greater if foundation conditions are poor as indicated by the existing boring data.

2. There are no existing channels available to the east shore of the site. All necessary dredging must be new dredging and a channel must be cut from the peninsula to the Arthur Kill.

3. A basin constructed in the Arthur Kill will have a 90 degree entrance alignment with respect to the existing navigational channel and tidal currents. Both of these will pose some navigational hazard to small crafts leaving and entering the basin. In addition, sediment carried by the tidal currents will be intercepted by man-made structures at the harbor mouth, causing sediment to be deposited in the entrance channel. This will require more frequent dredging in order to maintain a navigable channel.

4. The passage of commercial vessels in the Arthur Kill will generate large wakes. Wave amplitudes of 1 to 2 feet can be expected. This will undoubtedly cause discomfort to basin users.

5. A basin entrance orientation other than 90 degrees to the Arthur Kill will allow energy to be transmitted through the entrance during storm conditions.

A marina located on Smith Creek offers advantages that the other alternatives do not. These include the following.

1. An existing navigational channel already exists in Smith Creek and is maintained by the State. This is a less costly approach because the State is responsible for keeping the channel open.

2. The Smith Creek site is completely protected during storm conditions. No breakwater or protective structures are required. This offers a substantial cost savings.

3. Navigation will not interfere with large commercial vessels.

4. Navigation in and out of Smith Creek will be parallel with channel currents, although the magnitude of the currents are expected to be much less than those in the Arthur Kill.

Because of these advantages, a boat basin on Smith Creek is preferred.

3.2.3 Costs

The choice of a preferred marina layout on Smith Creek can be determined primarily on an economic basis. The greatest dollar cost in many marina designs is the edge treatment. Cost is both a function of length and type of edge treatment. Alternative I offers the least linear feet of edge and is nearly 1/2 the length of edge required under Alternatives II and V. By designing an articulated edge (as in Alternatives II and V), the cost may nearly double.

Edge Treatments

There are two basic types of edge construction; vertical sheet pile and sloped (Figures 16 and 17). The cost of vertical edge is about $1,500 to $2,000 per linear foot; whereas, a sloped edge is on the order of 1/3 to 1/5 the cost of vertical edge. Under certain soil conditions, vertical edges are necessary to provide edge stability. However, at this site, a rock slope graded at 3 on 1 (horizontal to vertical) appears to be a reasonable solution. A sloped edge offers advantages over a vertical section in that waves generated within the harbor by boat movement are dissipated at the edge rather than amplified and reflected off of vertical walls. This kind of agitation can be annoying in a boat basin.

Dock Systems

Where water levels do not fluctuate more than 2 feet the berthing docks and slips almost universally are of fixed construction. If the normal tide range is between 2 and 5 feet the use of a floating system is optional. For fluctuations of more than 5 feet, a floating dock system is highly recommended.

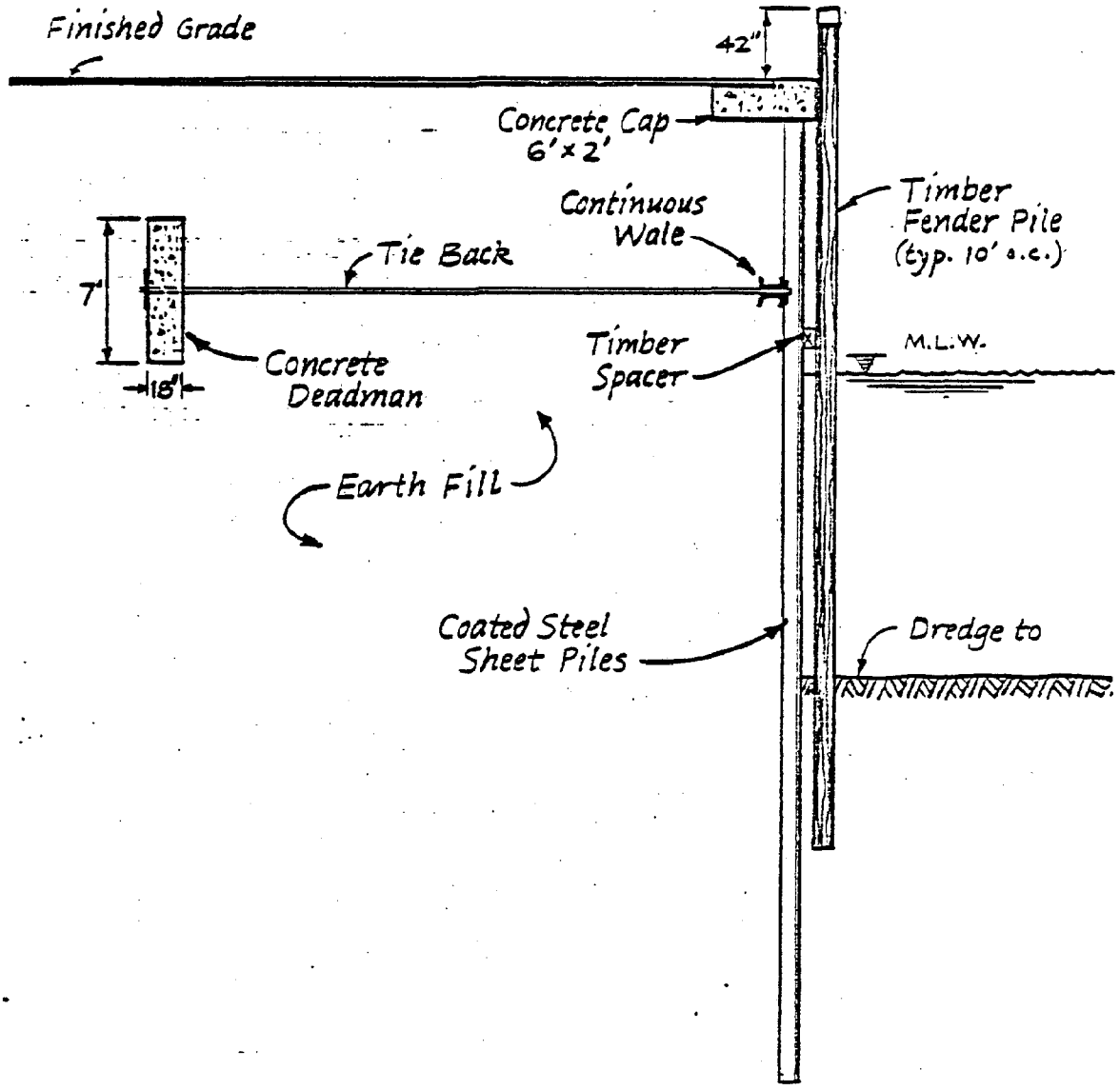
Three docking systems have been examined for the marina:

1. Foam-filled pre-cast concrete system (Figure 18).

2. Aluminum decked docking system (Figure 19).

3. Wood frame over foam-filled pontoons.

All of these systems were evaluated for engineering feasibility, aesthetics, and initial cost (Table 3). A ten year comparative cost analysis of wood vs. concrete docking system was conducted and is presented in Table 4.
The results of the analysis indicate that the pre-cast concrete system is the most cost-effective design. In addition, it offers better stability and durability.



Section C-C: Bulkhead

ALVIN P. WILLIAMS

MEMORIAL PARK

Sasaki Associates, Inc.
64 Pleasant Street, Watertown, Mass. 02172

Planning · Architecture · Landscape Architecture
Civil Engineering · Environmental Services

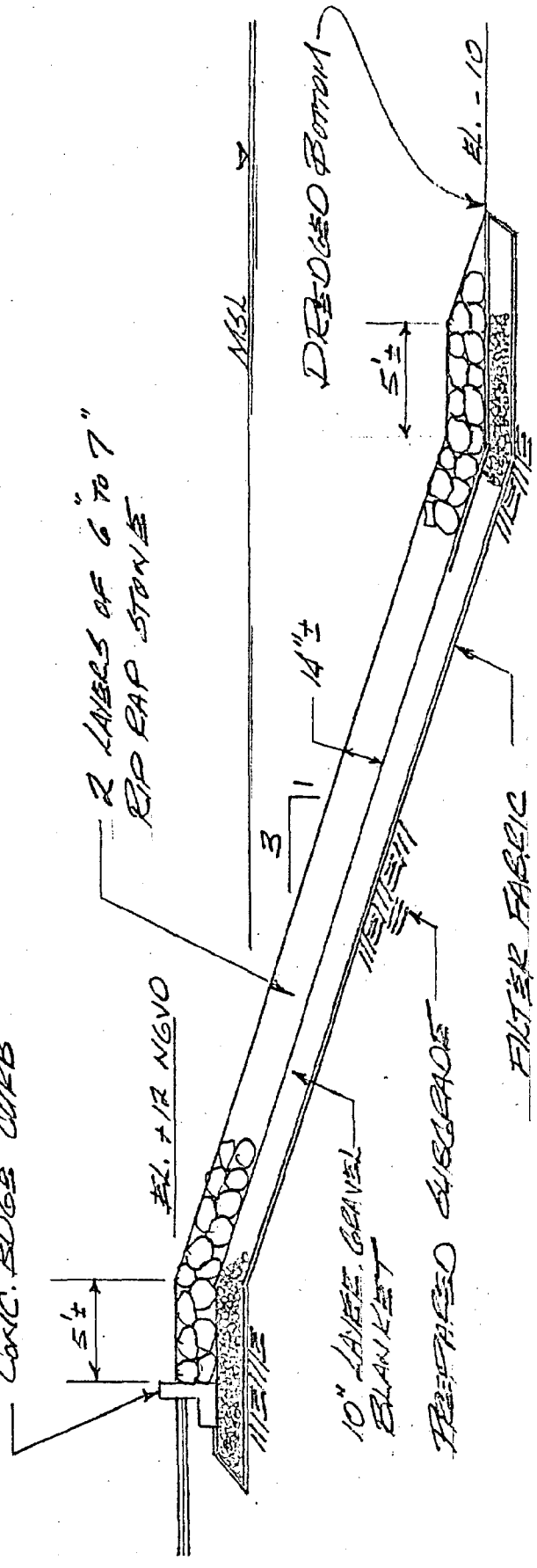
Project No. 0278 Revisions
Drawn By VHH
Checked By SBM
Approved By MF
Drawing Date 10/19/81 Sheet Number
Issue Date Figure 16
Scale

Figure 17

PROJECT NO. 0278-31 SASAKI ASSOCIATES, INC. SHEET NO. 17 OF

TITLE KENNEBEC 64 PLEASANT STREET DATE SEP. 28 81

WATERTOWN, MA 02172 BY VYH CK'D

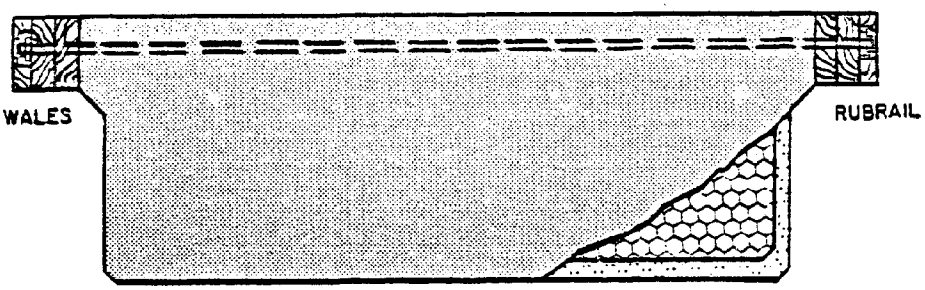


SCHEMATIC CROSS SECTION OF SLOPE PROTECTION

NOTE: N. SECTION REPRESENTS GENERAL CONDITION FOR CUT AND/OR FILL SECTIONS ACROSS TO SITE PLAN

"NOT TO SCALE"

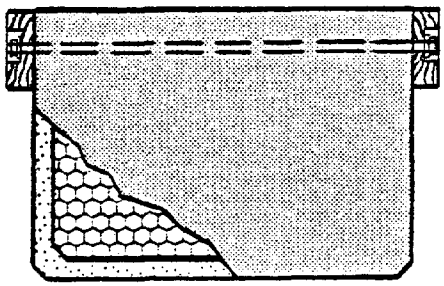
MODULES WITH WALERS ATTACHED



STEEL THRU RODS - SECURED WITH NUTS ON BOTH ENDS

CONCRETE COMPLETELY SURROUNDS EXPANDED POLYSTYRENE CORE AND BONDS TO IT

WALKWAY FLOAT END-VIEW



HARDWARE

ALL STEEL PARTS ARE HOT-DIP GALVANIZED AFTER FABRICATION

WOOD

DOUGLAS FIR TIMBER PRESSURE-TREATED WITH PENTACHLORAPHENOL

FINGER FLOAT END-VIEW

ALVIN P. WILLIAMS MEMORIAL PARK

Sasaki Associates, Inc.
64 Pleasant Street, Watertown, Mass. 02172

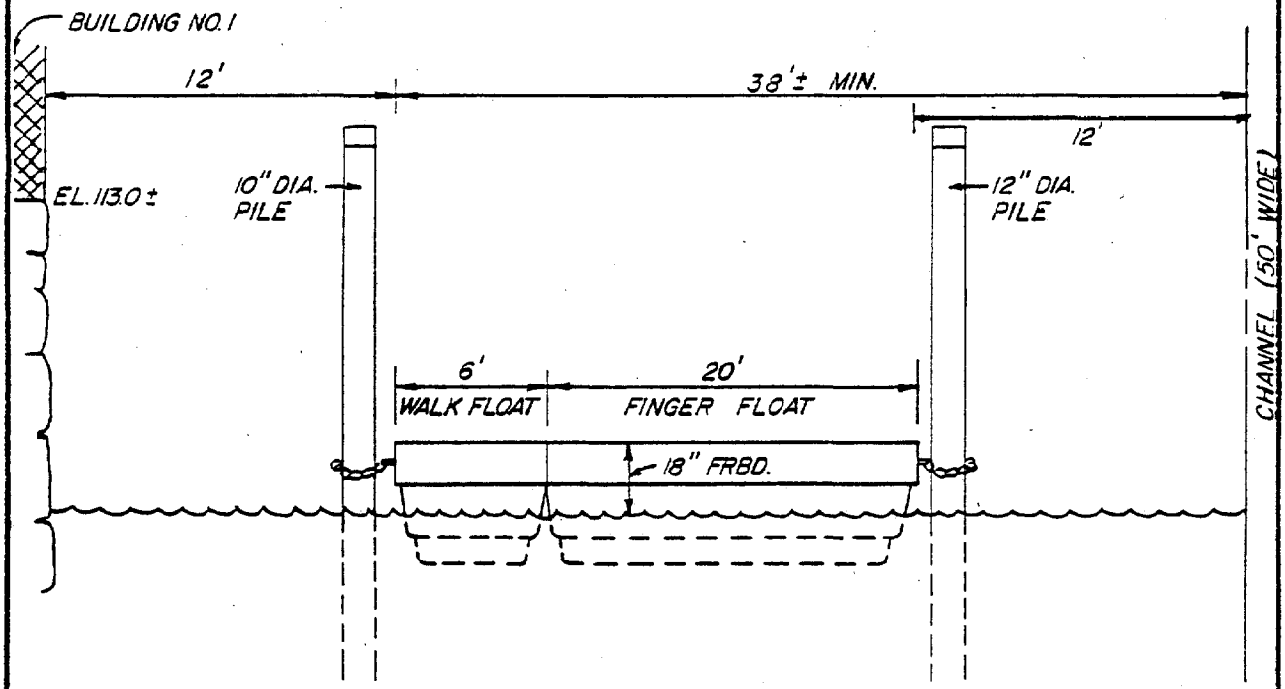
Planning · Architecture · Landscape Architecture
Civil Engineering · Environmental Services

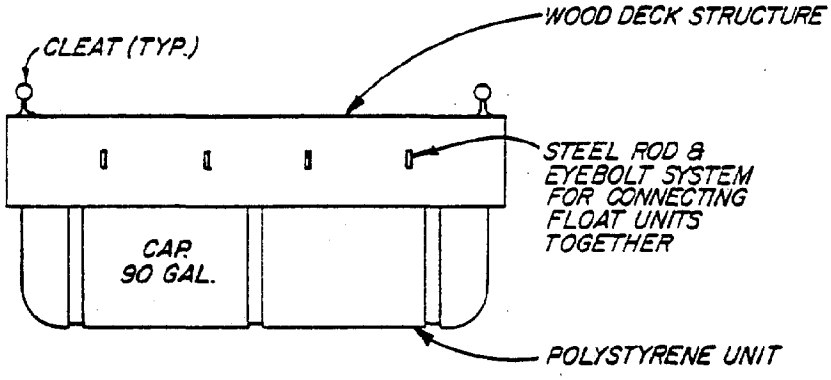
Project No. 0278
Drawn By VHH
Checked By SBM
Approved By MF
Drawing Date 10/19/81
Issue Date
Scale NTS

Revisions

Sheet Number

Figure 18





WEIGHT TOLERANCE: 700 LBS. PER UNIT (4' X 2')

TYPICAL FLOAT SECTIONS

N.T.S.

ALVIN P. WILLIAMS MEMORIAL PARK

Sasaki Associates, Inc.
64 Pleasant Street, Watertown, Mass. 02172

Planning · Architecture · Landscape Architecture
Civil Engineering · Environmental Services

Project No. 0278
Drawn By VYH
Checked By SBM
Approved By MF
Drawing Date 10/19/81
Issue Date
Scale

Revisions

Sheet Number

Figure 19

TABLE 3

FLOATING DOCK EVALUATION CHART

	Foam Filled Precast Concrete System	Marine Docks Alluminum Decked Dock System	Marine Docks Wood Frame Over Foam Filled Pontoon
Stability	Most Stable Walking Surface	Less Stable Walking Surface (Hinged Joint Sections)	Fairly Stable
Reaction to Waves	Best (effective up to 2½' wave)	Moderate	Good, Spaced Pontoons but Hinged Construction
Debris Collection in Water	Some Debris Collection because minimum clear space in between units	Less Debris because Pontoons are spaced	Less Debris because Pontoons are spaced
Noise	Quiet	Can be noisy because of many metal moving joints	Fair
Number of Guide Piles	Relatively Few	Relatively Many	Relatively Many
Appearance	Very Good	Good	Fair
Flexibility of System to Revision of Layout	Good	Fair	Fair
Durability & Maintenance	Very Good	Good	Fair
Cost	$22/sq. ft.	$16.5/sq. ft.	$16.5/sq. ft.

TABLE 4

LIFE-CYCLE COST COMPARISON

Wood vs. Concrete Floating Dock Systems

Comparison - To be based on a present worth analysis of docking system alternatives with different life-spans and annual maintenance costs assuming 8¼% annual interest (Township's borrowing rate) and no inflation for comparative purposes only.

Area of Floats = 29,732 s.f.

Wood System

First Cost - 29,732 s.f. @ $16.50/s.f. = $490,578

Annual Maintenance Cost = $13,023 (est.)

Anticipated life = 10 years
Assume a 50 year comparison

Present Worth (P.W.) = $A + B + P.W._{10} + \ldots P.W._{50}$

Where A = initial cost

B = Bond necessary for annual maintenance cost at 8¼%

$P.W._{10}$ = present worth of replacement cost after 10 years

$P.W._{50}$ = present worth of replacement costs at 50 years

P.W. = $490,578 + $154,856 + $216,145 + $97,828 + $44,279 + $20,040 + $9,070 = $1,032,796

Concrete System

First Cost - $29,732 s.f. @ $22/s.f. = $654,104
Annual maintenance = $5,000 (est.)
Anticipated life = 25 years
P.W. = $654,104 + $59,455 + $89,457 + $12,329 = $815,345

3.2.4 Preferred Design

Based on the foregoing evaluations and an assessment of the existing site conditions, Alternative I has been selected as the preferred marina layout. The marina will have a capacity of 264 boats, and the mix will consist of the following:

Craft Size	Quantity
20'	26
25'	66
30'	80
35'	68
40'	24

The area needed for boat mooring will be about 6.0 acres. The proposed marina layout is presented on the Master Plan. The docking system will be pre-cast, foam-filled, concrete floats set in place with wood timber guide pile (See Figures 18, 20-23). The section will be designed to withstand waves up to 2 feet.

The edge will consist of a double layer of graded dumped rip rap. Primary layer stone will consist of 6 to 7 inch diameter stone, and the base layer will be crushed stone (Figure 17).

Fuel pumping and dispensing systems will be supplied at the south end of the harbor, along with other marina services (Figure 24). Sewer pumpout facilities also will be provided. A boat launching ramp is planned at the north end of the marina.

3.2.5 Dredging

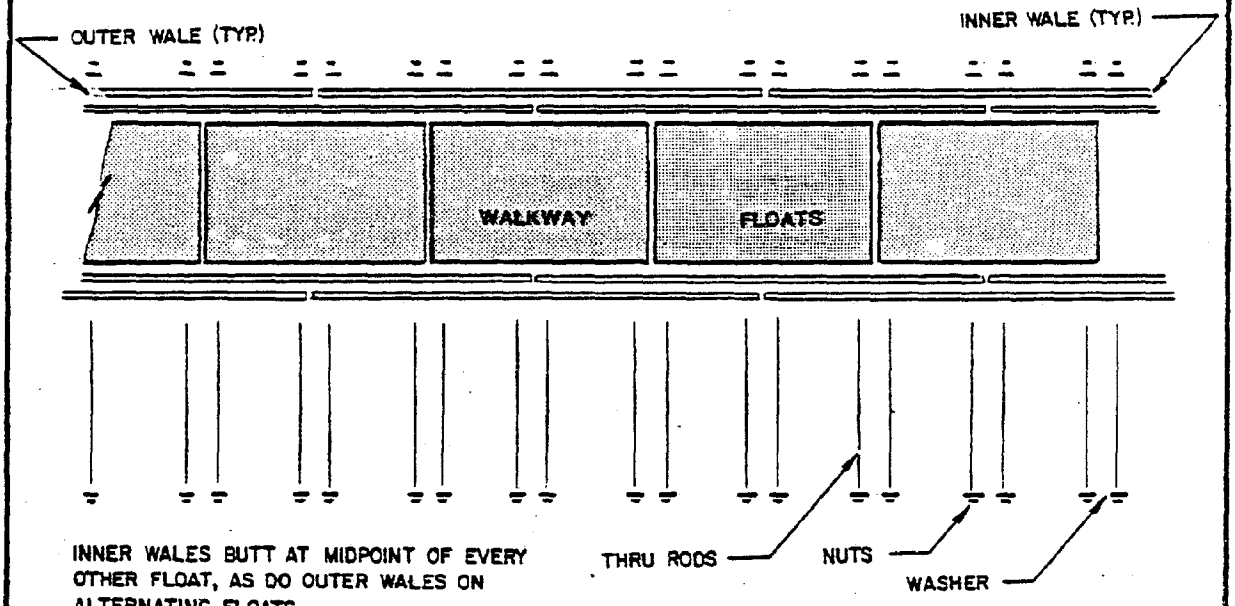
Construction of the harbor will require considerable excavation. From elevation +10 (existing land surface) to elevation -2 (NGVD), the removal of material will be considered excavation (above mean low water elevation). The estimated quantity of excavation is 145,000 cubic yards. Much of this material is old hydraulic fill and will be utilized to raise existing grades throughout the site.

From elevation -2 to -10 (NGVD) the removal of material will be completed by dredging. Approximately 92,500 cubic yards will be removed during this operation.

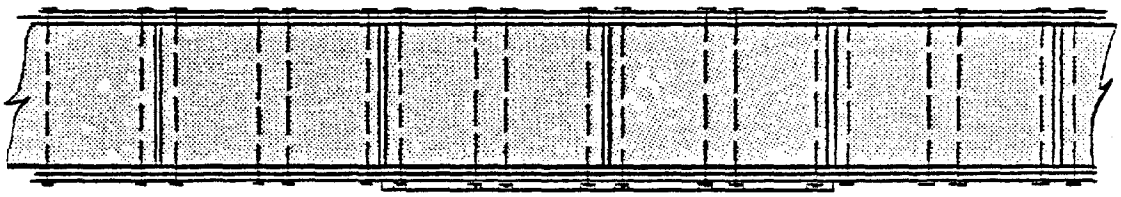
The initial cost of dredging is estimated at $555,000.

Based on local dredging records, the frequency of maintenance dredging is estimated at no less than 15 years.

WALKWAY ASSEMBLY



UNASSEMBLED PLAN VIEW



RUBRAIL ALONG BOTH SIDES WILL BE PROVIDED AFTER ASSEMBLY (ONLY ONE SECTION SHOWN HERE)

ASSEMBLED WALKWAY

ALVIN P. WILLIAMS

MEMORIAL PARK

Sasaki Associates, Inc.
64 Pleasant Street, Watertown, Mass. 02172

Planning · Architecture · Landscape Architecture
Civil Engineering · Environmental Services

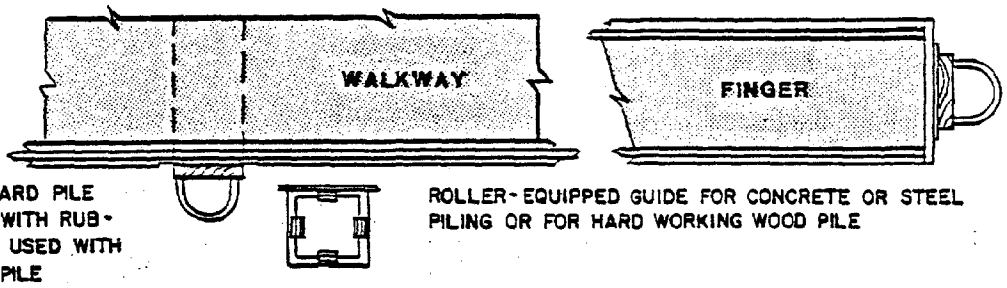
Project No. 0278
Drawn By VHH
Checked By SBM
Approved By MF
Drawing Date 10/19/81
Issue Date
Scale NTS

Revisions

Sheet Number

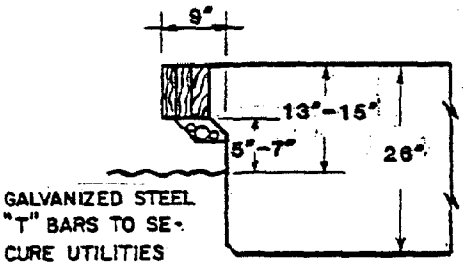
Figure 20

ATTACHMENT OF PILE GUIDES AND UTILITIES

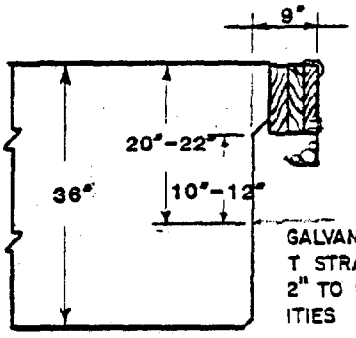


STANDARD PILE HOOP WITH RUB-BLOCK USED WITH WOOD PILE

ROLLER-EQUIPPED GUIDE FOR CONCRETE OR STEEL PILING OR FOR HARD WORKING WOOD PILE



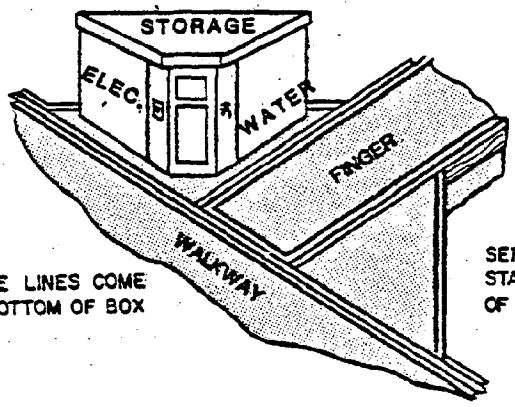
GALVANIZED STEEL "T" BARS TO SECURE UTILITIES



GALVANIZED STEEL T STRAP 1/4" X 2" TO HOLD UTILITIES

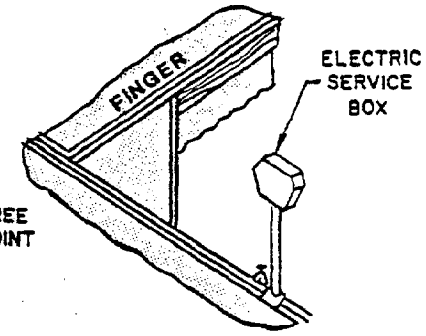
STANDARD FLOAT

HIGH FREEBOARD FLOAT



SERVICE LINES COME INTO BOTTOM OF BOX

SERVICE CAN BE FREE STANDING AT MID POINT OF SLIPS



ALVIN P. WILLIAMS

MEMORIAL PARK

Sasaki Associates, Inc.
64 Pleasant Street, Watertown, Mass. 02172

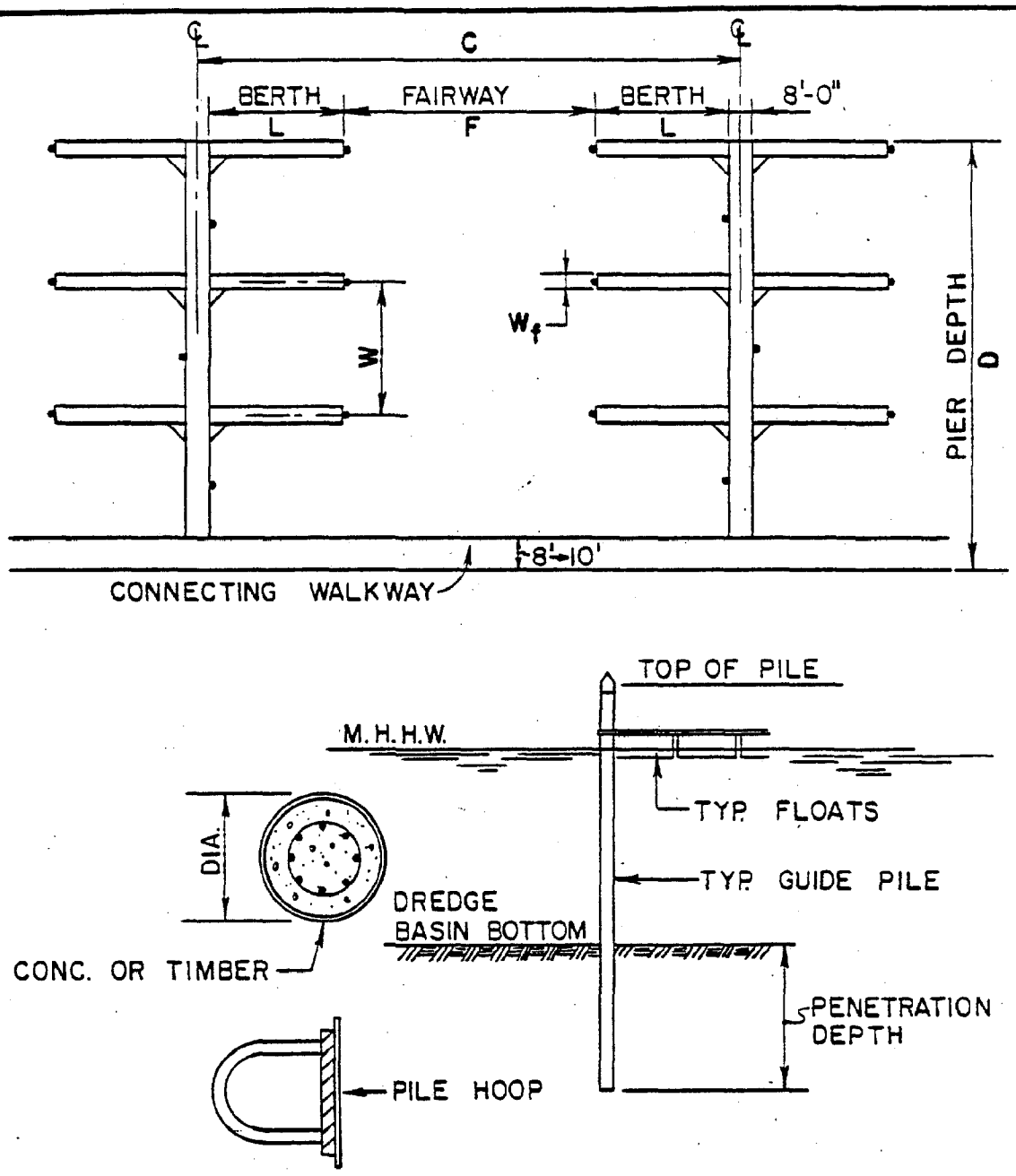
Planning · Architecture · Landscape Architecture
Civil Engineering · Environmental Services

Project No. 0278
Drawn By V4H
Checked By SBM
Approved By MF
Drawing Date 10/19/81
Issue Date
Scale NTS

Revisions

Sheet Number

Figure 21



TYPICAL LAYOUT FOR FLOATING DOCKS

ALVIN P. WILLIAMS

MEMORIAL PARK

Sasaki Associates, Inc.
64 Pleasant Street, Watertown, Mass. 02172

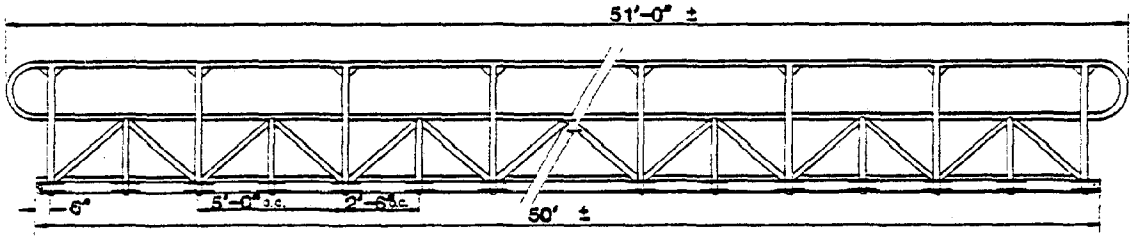
Planning · Architecture · Landscape Architecture
Civil Engineering · Environmental Services

Project No. 0278
Drawn By VHH
Checked By SBM
Approved By MF
Drawing Date 10/19/81
Issue Date
Scale

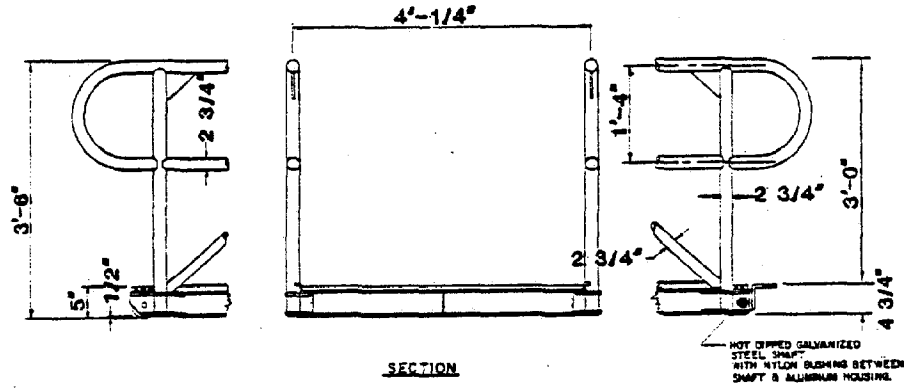
Revisions

Sheet Number

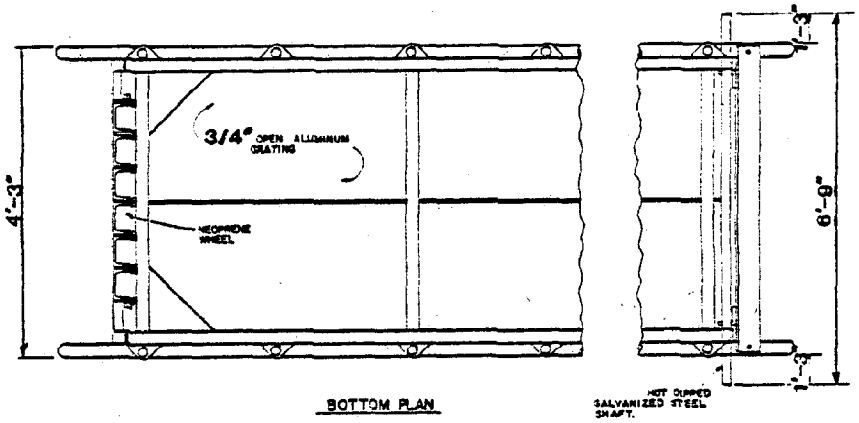
Figure 22



ELEVATION



SECTION



BOTTOM PLAN

TYPICAL GANGWAY DETAIL

NOT TO SCALE

ALVIN P. WILLIAMS

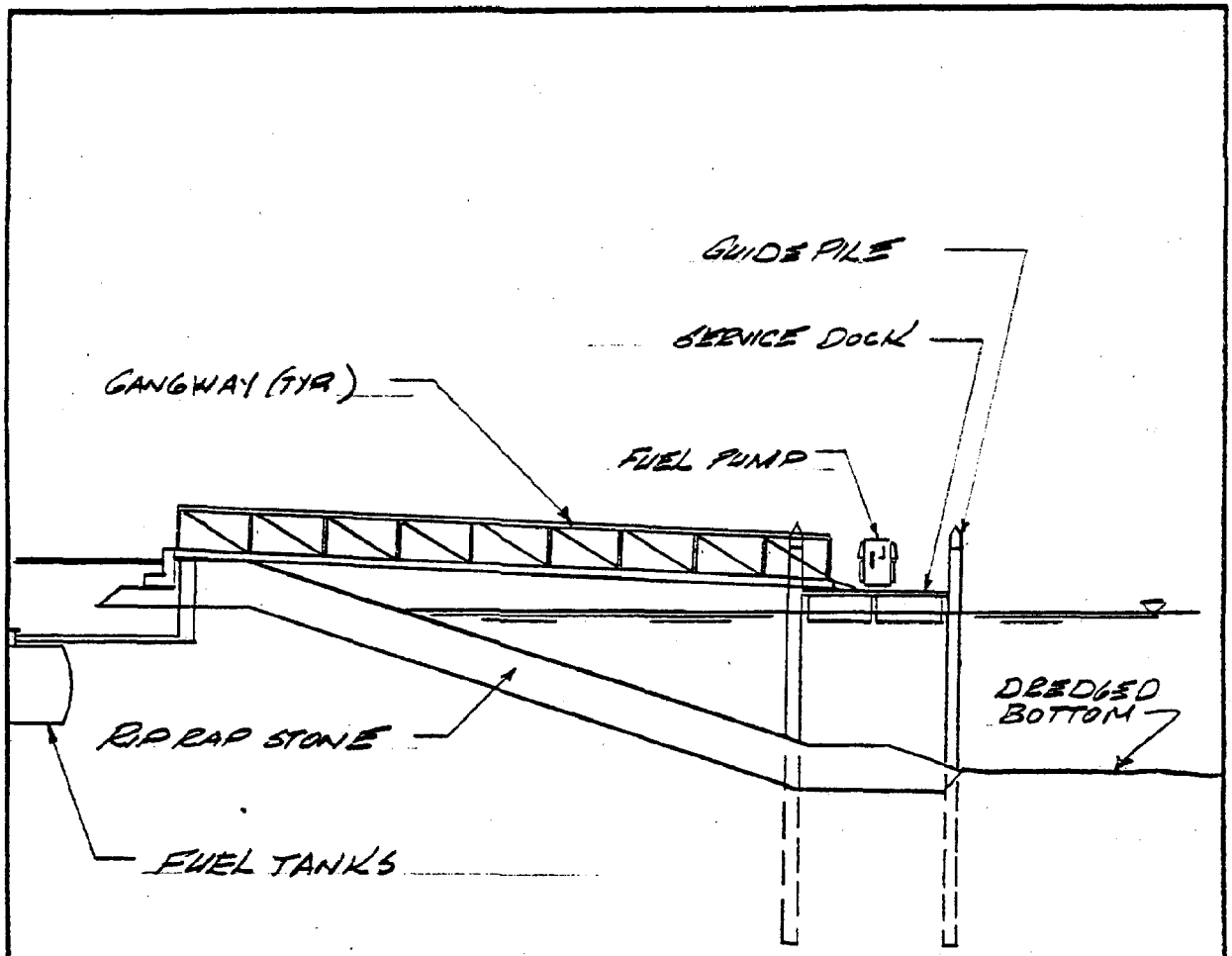
MEMORIAL PARK

Sasaki Associates, Inc.
64 Pleasant Street, Watertown, Mass. 02172

Planning · Architecture · Landscape Architecture
Civil Engineering · Environmental Services

Project No. 0278 Revisions
Drawn By VAH
Checked By SBM
Approved By MF
Drawing Date 10/19/81 Sheet Number
Issue Date
Scale NTS

Figure 23



TYPICAL FUEL DOCK

ALVIN P. WILLIAMS MEMORIAL PARK

Sasaki Associates, Inc.
64 Pleasant Street, Watertown, Mass. 02172

Planning · Architecture · Landscape Architecture
Civil Engineering · Environmental Services

Project No. 0278
Drawn By VYH
Checked By SBM
Approved By MF
Drawing Date 10/19/81
Issue Date
Scale

Revisions

Sheet Number

Figure 24

The State of New Jersey recently has submitted an application to dredge Smith Creek. Their application is under review by the Division of Water Resources. The State wants to remove 26,000 cubic yards from the existing channel and would like to dispose of this material on the park site. However, Woodbridge does not want this material on this site. It may be beneficial, from both a cost and permitting standpoint, to coordinate these dredging efforts. The Division of Water Resources may allow "piggybacking" of the Sewaren, water quality certification application with that proposed for Smith Creek by the State Bureau of Coastal Engineering.

Disposal of dredge spoil may be by one of two methods, ocean or land disposal. The feasibility of one method or the other depends somewhat on the chemical constituents of the spoil. A full discussion of dredge spoil disposal including costs will be conducted in late phases of the planning process once chemical sampling and bioassays are complete.

4.0 MASTER PLAN PROGRAM

The 36 acre site has been divided into three major zones: Boat Basin, Open Space/Recreation, and Nature Study. The following plan illustrates the distribution and size of these zones.

4.1 Site Access

Temporary access to the Park will be required for construction and general park uses until the Sewer Treatment Plant is removed from its location. At such time, a permanent access off Cliff Road should be built as shown on the Master Plan. Traffic improvements, such as moving the entrance 300 feet south of the intersection, widening Cliff Road and improving the Cliff Road/Central Avenue intersection, are recommended.

Access to the peninsula will be via a new dike crossing at Smith Creek, on the bend near the north east boundary of the project.

Circulation within park areas will be controlled with chain gates at the overflow parking lot and the Harbor Masters Building. Only Park vehicles will be allowed access into the pedestrian areas of the Park.

4.2 Boat Basin

The boat basin is located on the existing Smith Creek Channel. Modest excavation is expected in this location because the existing grade is lowest along the creek.

Floating slips will provide space for 264 boats ranging from 20 to 40 feet. Facilities for fueling and for a harbor master's activities are provided. Additionally, a restaurant, to be operated on a lease basis, is proposed in proximity to the best views of the basin. Parking for boat users is provided at a ratio of .75 cars per boat. Restaurant parking will accommodate 50 cars. A dual-lane boat launch ramp with 40 car/trailer spaces is proposed at the upper arm of the boat basin.

4.3 Open Space/Recreation

The access road terminates in a parking cul-de-sac for 20 cars. A "Wave Garden", featuring nautical elements, will be developed in a manner which is interpretive, attractive, and functional. It is the keystone of the Park because it will establish the theme of a water oriented facility. Other open space uses are related to the location of the site on the Arthur Kill Channel. These are picnic areas, promenade, tot playground, and a general, multi-purpose, open lawn area for various events.

4.4 Nature Study Area

The effects of development of the Sewaren peninsula on wildlife will be mitigated partially by enhancement of the existing habitat at the tip of the site. A nature interpretation pavillion will mark the entry to trails which will wind through reconstructed upland and lowland habitats. Large areas of plantings will be retained to encourage wildlife. A trail will pass a 30 foot observation tower. This tower will become a navigational aid to boaters. Further along the trail, a marsh and mud flat habitat will be encountered. A boardwalk is proposed to minimize impacts.

4.5 Summary of Park Facilities

A. Boating:

Boat Basin - 264 Boats
Harbor Master and Fuel Facilities (Floating Dock)
Restaurant
Boat Launch - 40 car/trailers

B. Open Space/Recreation:

Wave Garden
Tot Lot
Picnic Facilities
Promenade
Overlook seating
Multi-purpose lawn area.

C. Nature Study:

Nature Pavillion
Interpretive Trails
Observation Tower
Boardwalk
Upland and Lowland habitat reconstruction

D. Parking:

Boat Uses -	190 spaces
Restaurant -	50 spaces
Nature Study -	25 spaces
Overflow Parking-	70 spaces
Total :	335 spaces

4.6 Preliminary Cost Estimate

The cost estimates as projected by Sasaki Associates for the marina and park elements totals $5,450,000. A preliminary cost estimate is attached.

Boat basin preparation, access roads, utilities, water edge preparation, floats, and gangways will cost an estimated $3,635,000. These elements constitute the essential items for a working marina to be estblished and put into operation.

The marina is the focal point of the park development and it should be constructed and put into operation in the initial or first phases, if construction is phased.

Approximately $1,825,000 are necessary for the boat launch ramp and parking, park landscaping and lighting, nature center and trails and the observation tower. These elements are not essential to the marina operation and could be added in later phases.

Projected cost estimates do not include the restaurant, Harbormaster building, and the fuel station. These items are to be constructed and funded by the private developer or operator.

If the project must be phased, for whatever reason, it is recommended that the marina be implemented initially with the remaining elements added at a later time. This phasing schedule would allow the marina, restaurant, and harbormaster elements to commence operation initially with the park elements being added later.

4.7 Funding Sources

Funding of the total cost of $5,450,000 can be accomplished by a combination of N.J Green Acres funds,

SA

Sasaki Associates, Inc., 64 Pleasant Street, Watertown, Massachusetts 02172 · (617) 926-3300 Telex 92-2471

JOB Sewaren Waterfront Park COST ESTIMATE STATUS Budget DATE 9/30/81 BY SBM

ITEM	QUANTITY	UNIT	UNIT COST	ITEM TOTAL	SUB TOTAL	REMARKS
MARINA BAY						
Slope Rock Revet.	1,865	LF	$ 345	$ 643,425		12" of 6"-8" stone, 3:1
Floats	29,732	SF	22	654,104		Foam-filled precast conc.
Guide Piles	155	EA	765	118,575		45LF Each $17/LF; 14" Ø
Gangways	3	EA	8,000	24,000		
Boat Launch	230	CY	300	69,000		2 Lanes
Excavation	161,000	CY	4	644,000		Excav. & Re-use or give away (No Cost Spoil)
Dredge	92,500	CY	6	555,000		Spoil at Sea, Sandy Hook Mud Dump
					$2,708,104	
SITE IMPROVEMENTS						
Fill (For dike cross)	11,000	CY	4	44,000		For entrance road
Twin Culverts (Dike)	200	LF	225	45,000		From Smith Creek under dike crossing
Trees	122	EA	300	36,600		Larger - $350 Smaller- $250 average
Shrub Areas	113,132	SF	3	339,396		Some on Slopes
Turf Areas	392,202	SF	0.60	235,321		Loam and Sod
Wave Garden	Allow			100,000		w/conc. wave sculpture
Tot Lot	Allow			53,000		w/timber structure
Observation Tower	Allow			125,000		Timber
Curb (asphalt)	4,000	LF	2	8,000		Where Required
Lighting	Allow			50,000		Main Road
Timber Terrace Area	Allow			167,000		Timber, earth
Bit. Conc. Pavement	31,725	SY	6.90	218,903		3½" B.C. on 12" Base
Nature Trail Areas	Allow			217,450		Trails, board walks, natural plant materials
Nature Center	1,000	SF	50	50,000		
					$1,689,670	

SA

Sasaki Associates, Inc., 64 Pleasant Street, Watertown, Massachusetts 02172 · (617) 926-3300 Telex 92-2471

JOB Sewaren Waterfront Park COST ESTIMATE STATUS Budget DATE 9/30/81 BY SBM

ITEM	QUANTITY	UNIT	UNIT COST	ITEM TOTAL	SUB TOTAL	REMARKS
UTILITIES						
Water	Allow			$ 67,000		8" main, Hyd, service
Sewer	Allow			54,000		6" main, twin 3" force, manholes, pump station
Drainage	Allow			25,000		
					$ 146,000	
SUBTOTAL PUBLIC FUNDS					4,543,774	
GRAND TOTAL w/20% Contingency & Engineering					$5,452,529	
				SAY	$5,450,000	

Township of Woodbridge bonding, and private developer/operator capital. Department of Energy Coastal Energy Impact Program (CEIP) funding, in the form of a loan, was planned originally as a funding source, but is no longer available, due to recent cutbacks in Federal spending.

The following allocation of funding is suggested:

Funding Allocation

Green Acres 50%	$2,725,000
Woodbridge 50%	$2,725,000
TOTAL	$5,450,000

It is beyond the scope of this analysis to allocate funding by individual marina and park elements and to identify the timing of the funding. A more detailed funding allocation must be based on the review by the New Jersey Department of Environmental Protection - Green Acres Program utilizing their criteria for eligibility for funding by element. This detailed analysis should be done in the future and is incorporated as part of the Phase II work scope for this particular project.

Funding Sources - Woodbrige Share of Cost

The Township of Woodbridge's share of cost in the amount of $2,725,000 can be derived from a series of funding sources.

Unfortunately, at the present time, because of Federal Government cutbacks, two sources of funding have been eliminated. These include grants from the HCRS Land and Water Conservation Fund, administered by the U.S. Department of the Interior, and loans from the CEIP Formula Grant, Section 308 (b), administered by the U.S. Department of Commerce.

The Township's share can be derived from CDBG sources, if available, and through a Township backed bond issue.

A portion of the debt service for the bond issue can be supplied by a land lease of the marina and restaurant facilities. If the marina facilities, including docks and gangways, are constructed and leased to an operator, lease payments can be based on a percentage of the gross or net income. Gasoline sales, chandlery and other retail sales, if part of the marina operation can be included in the gross income figures.

The restuarant and ancillary retail facilities are projected to be constructed and operated by private developers or operators.

Land under the restuarant and retail facilities can be leased to the operator with land lease payments based on the appraised land value or a portion of the restaurant gross income.

Financial analysis of land lease income for both the marina and restaurant elements are beyond the scope of this engineering cost analysis. Future studies should include a market study of both the marina and restaurant elements and the increase in these payments over time. This market and financial analysis should be done to determine the annual land lease payments from the Park which can be used to repay the annual principal and interest payments on Township issued bonds.

Preliminary analysis of marina and restaurant land lease income show these combined annual payments being able to support between $550,000 and $1,000,000 of the Townships $2,725,000 share. These are preliminary estimates only and must be verified by detailed market and financial studies in the future.

5.0 ENVIRONMENTAL ANALYSIS

5.1 Existing Conditions

The proposed Sewaren Waterfront Park site, a 36± acre peninsula located at the confluence of Smith Creek and the Arthur Kill, presently is a patchily-vegetated, dredge disposal site. Surrounded by oil storage facilities, power stations, sewage treatment plants and residences, the site is the only remaining vacant waterfront parcel in the Sewaren area.

The site is composed of four distinct cover types: upland waste area, beach, salt marsh, and mud flats. The upland area is characterized by scattered small trees and shrubs, grasses, and waste-area species (i.e. goldenrods and Queen Anne's lace).

The beach is pebbly and contains a large amount of trash deposited by the rivers. The salt marsh is narrow but maintains a dense growth of Spartina alterniflora and foxtail reed grass. The mudflats are sparcely vegetated, but extensive, particularly along the shore of the Arthur Kill.

Runoff from the site is controlled by a permiter dike and exits via a single open channel into the Arthur Kill. Erosion and siltation are uncontrolled. Due to the nature of the peninsula's substrate, water quality of the runoff is expected to be poor.

Although no water quality testing has been conducted, the quality of Smith Creek is expected to be poor due to the industrial nature of the surrounding land and low velocity current.

5.2 Impacts of the Proposed Project

5.2.1 Land Use Changes

Construction of the proposed Sewaren Waterfront Park will change the use of the upland area from a vacant, dredge spoil site to a public park. This change in land use will result in greatly needed open space/park land and public access to the Arthur Kill.

5.2.2 Noise

The proposed project will not alter significantly the existing noise levels in the vicinity of the site, except during the construction process when heavy equipment such as trucks, backhoes, pile drivers, etc., will be operated.

5.2.3 Air Quality

The construction process will produce a small, temporary increase in air pollution resulting from exhaust emissions from equipment. No significant impacts to air quality are expected during the operational phase.

5.2.4 Historic and Archaeologic Resources

No historic or archaeologic resources will be affected by construction of the park. However, the presence of the park in place of a vacant, spoil site will enhance the historic features of the Woodbridge waterfront.

5.2.5 Wildlife

Construction of the waterfront park will result in the replacement of 17.34± acres of shrub and waste-area habitat with open parkland. An additional 9.83 acres, including 2.8± acres of salt marsh, will be replaced by the marina and associated park facilities. In addition to this loss of habitat area, the increased human use of the site will result in the displacement of sensitive species.

5.2.6 Fisheries

All dredging activities will result in a temporary increase in turbidity. This in turn will have impacts on the existing shellfish and finfish. The existing shellfish are contaminated and thus, inedible; however, they are of value as a food source for other species. The site is within the potential habitat range of three protected fish species: shortnose sturgeon, Atlantic sturgeon, and Atlantic Tomcod. It is highly unlikely, however, that these species actually utilize either Smith Creek or the Arthur Kill, due to the contaminated, low oxygen condition in these waterways.

Safe fishing sites (i.e. structurally sound public piers, wharves, etc.) are rare along this portion of the New Jersey Coast. Construction of the marina wharves and piers will increase access to fishing at this site.

5.2.7 Vegetation

Development of the Sewaren peninsula into a waterfront park will require nearly complete alteration of the existing vegetative cover above the 10 foot contour (NGVD). All salt marsh and mud flat vegetation, with the exception of 2.8± acres of salt marsh located across the entrance to the proposed boat basin, will remain undisturbed.

The completed park will be vegetated to include the following associations: hedge buffer (0.60± acres), woodland buffer (1.68± acres), mixed woodland/thicket (5.74± acres), and open parkland grasses and trees (17.34± acres). Therefore, post development conditions will have a greater vegetation coverage (25± acres) than predevelopment conditions (20 ± acres).

5.2.8 Water Quality

During the construction process, specifically when fill is placed for the access road crossing and when the entrance to the proposed boat basin is dredged,

there may be a local increase in water turbidity and reduced water quality. Since the water quality of Smith Creek may be poor already, this impact may not be significant.

Following construction of the park, a localized improvement in the water quality of Smith Creek may be expected. Park creation will result in stabilization of the presently unvegetated portions of the Sewaren peninsula through the use of landscape materials; thereby reducing erosion and siltation. Furthermore, runoff from the park surfaces is expected to be of higher quality than that from exposed dredge spoils.

5.2.9 Erosion

Erosion will be controlled during the construction phase through the use of a soil erosion/sediment control plan. This plan may include phasing of development to reduce the amount of exposed area at any given time, use of check dams and/or use of temporary, slope stabilization materials.

Construction of a park on this site will reduce the potential for erosion by stabilizing all presently exposed areas with landscape materials.

5.2.10 Socioeconomics

The socioeconomic impacts of the proposed waterfront park will be twofold. First, the construction process will provide jobs and a market for local materials. Second, the park will provide Woodbridge with public access to Smith Creek and the Arthur Kill, a place to fish (finfish only), and a place for enjoyment of leisure time and cultural development.

5.3 Mitigation Measures

5.3.1 Wildlife

Although development of a waterfront park will result in a loss of habitat acreage, this loss may be mitigated through the use of landscape materials which are attractive to wildlife, protection and increased maintenance of the beach areas, habitat improvement in an area designated as a nature preserve, maintenance of vegetative buffers, and marsh creation or rehabilitation.

Vegetation which is of value to New Jersey wildlife and which may be used for landscaping on dredge spoil sites is presented in Table 5. Many of these species

may be used to create a shrub buffer between the park and the beach area. This buffer will effectively limit direct human access to the beach and prevent harassment of shorebird populations. It also will provide "hedge row" habitat for songbird species.

The beach area should be kept clear of trash. This should be included as part of the maintenance program for the park.

A 5.74± acre nature preserve will be created as one of the park elements. This preserve will be vegetated with species listed in Table 5. Human access to this preserve will be limited to a loop trail system. Such a trail system will allow the public to observe wildlife species in their natural environment while, at the same time, limiting the amount of area which is subject to direct human/wildlife interaction.

An additional, vegetated buffer zone will be created in the northeast portion of the site. This will be a small woodland area which will contain a large variety of vegetation species, and provide habitat for a diverse songbird community.

Loss of 2.8± acres of salt marsh, due to the construction of the boat basin, may be mitigated by either creation of a new marsh or rehabilitation (improvement) of an existing marsh. In either case, such activities should be conducted in the immediate vicinity of the loss, and the following guidelines should be used:

- marsh elevations should be within the normal tidal range for the area (i.e. above mean low water and below mean high water);
- slope should be gradual, preferably one to three percent;
- the site must not be exposed to greater than moderate levels of wave energy;
- a thorough assessment of the substrate should be made prior to planting;
- the marsh should be planted with smooth cordgrass (Spartina alterniflora);
- new plantings should be adequately protected until established.

TABLE 5. DREDGE SPOIL-TOLERANT VEGETATION OF VALUE TO NEW JERSEY WILDLIFE*

Eastern Redcedar
Black Cherry
Canadian Serviceberry
Redstem Dogwood
Winterberry
Wax Myrtle
Bayberry
Common Chokecherry
Dwarf Sumac
Smooth Sumac
Carolina Rose
Allegheny Blackberry
American Elderberry
Highbush Blueberry
Sawbrier
Greenbrier
Summer Grape
Riverbank Grape
Frost Grape
Redroot Pigweed
Ragweed
Woolly Croton
Chufa
Common Filaree
Marsh Pea
Flat Pea
Sericea Lespedeza
Black Medick
Pokeberry
Pennsylvania Smartweed
Sheepsorrel
American Beechgrass
Smooth Crabgrass
Large Crabgrass
Tall Fescue
Red Fescue
Shoredune Panicium
Switchgrass
Reed Canary Grass

* Actual plant selection must be based on an accurate and complete assessment of the existing soil conditions.

5.3.2 Fisheries

Impacts to the fisheries resource, and particularly the protected species (if present), will occur during dredging operations. To reduce these impacts, dredging should be conducted using a hydraulic dredge during late November, December or January.

5.3.3 Vegetation

Refer to salt marsh mitigation measures presented under Wildlife.

5.3.4 Water Quality

During construction, impacts to water quality will result from dredging operations. To reduce these impacts, it is recommended that a hydraulic dredge be used. If necessary, a retention device (i.e. silt curtain or sheet piles) should be considered.

During marina operation, care should be taken to ensure that oil spillage is kept at a minimum. This can be accomplished by proper pump maintenance and operator care.

5.4 Unavoidable Adverse Environmental Effects

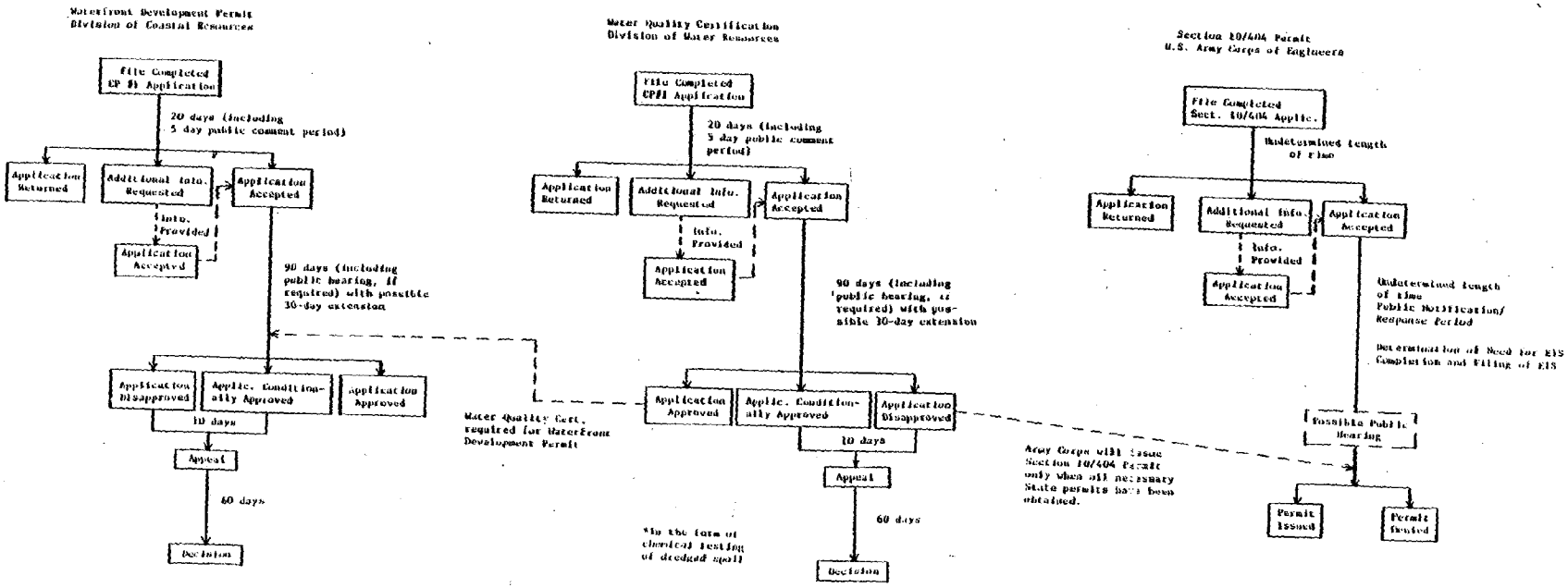
Construction of the proposed waterfront park will produce the following adverse environmental effects that cannot be avoided:

- a temporary increase in noise and air pollution levels during the construction phase of the project;
- loss of a land disposal site for dredged materials;
- a temporary decrease in site use by wildlife species during the construction phase of the project;
- a temporary increase in turbidity in Smith Creek during dredging operations;
- loss of contaminated shellfish in the area to be dredged.

5.5 Environmental Permit Requirements

The following environmental permits are required before the waterfront park project may proceed.

Permit	Agency
Waterfront Development Permit	New Jersey Division of Coastal Resources
Water Quality Certification	New Jersey Division of Water Resources


Waterfront Development Permit
Division of Coastal Resources
File Completed CP 81 Application
20 days (including 5 day public comment period)
Application Returned
Additional Info. Requested
Application Accepted
Info. Provided
Application Accepted
90 days (including public hearing, if required) with possible 30-day extension
Application Disapproved
Applic. Conditionally Approved
Application Approved
10 days
Appeal
60 days
Decision
Water Quality Cert. required for Waterfront Development Permit
Water Quality Certification
Division of Water Resources
File Completed CP81 Application
20 days (including 5 day public comment period)
Application Returned
Additional Info. Requested
Application Accepted
Info. Provided
Application Accepted
90 days (including public hearing, if required) with possible 30-day extension
Application Approved
Applic. Conditionally Approved
Application Disapproved
10 days
Appeal
60 days
Decision
*In the form of chemical testing of dredged spoil
Army Corps will issue Section 10/404 Permit only when all necessary State permits have been obtained.
Section 10/404 Permit
U.S. Army Corps of Engineers
File Completed Sect. 10/404 Applic.
Indeterminate length of time
Application Returned
Additional Info. Requested
Application Accepted
Info. Provided
Application Accepted
Indeterminate length of time
Public Notification/ Response Period
Determination of Need for EIS
Completion and Filing of EIS
Possible Public Hearing
Permit Issued
Permit Denied

Section 404 Permit U.S. Army Corps of Engineers

The following critical path diagram illustrates the steps involved in obtaining these permits.

The Waterfront Development Permit and the Water Quality Certification both require the filing of a CP#1 Application. This application is referred to as the 90-day Construction Permit Application. A maximum period of 90-days is required between the filing of a complete permit application and the issuance of the appropriate permit/certification. The Division of Coastal Resources and the Division of Water Resources will confer during the course of the ninety days because Water Quality Certification is a requirement for the Waterfront Development Permit.

No time limitations for the U.S. Army Corps of Engineers Section 10/404 Permit are specified in the permit regulations. The maximum length of time elapsing between the filing of a permit application and the issuance of a permit by the Corps is dependant upon the completeness of the application, whether an Environmental Impact Statement (in compliance with the National Environmental Policy Act) is required, and the work load at the Corps at the time of filing. The Army Corps requires that all necessary state permits be obtained before it will issue a Section 10/404 Permit.

Based upon the fact that some permits are prerequisites for obtaining others, it is critical that all three permit applications be completed and filed simultaneously so that interactions between the agencies can occur throughout the permitting process.

APPENDIX I

BIBLIOGRAPHY

For New Jersey in General:

1. NOAA, 1980, Local Climatological Data - Annual Summary with Comparative Data, Newark, NJ.

2. NOAA, 1965 to 1974, Airport Climatological Summary, Newark Airport, NJ.

3. Soil Conservation Service, 1978, Interim Soil Survey of Middlesex County, NJ.

4. Department of Environmental Protection, Division of Water Resources, 1981, The New Jersey Statewide Water Supply Master Plan (Draft), 138 p.

5. Rutgers University, College of Engineering, 1953, Engineering Soil Survey of New Jersey - Middlesex County, Engineering Research Bulletin No. 24, Report No. 10.

6. Owens, J.P. and Minard, J.P., 1979, Upper Cenozoic Sediments of the Lower Delaware Valley and the Northern Delmarva Peninsula, Delaware, and Maryland, U.S. Geological Survey Professional Paper 1067-D, 47 p.

7. Gill, H.E. and Farleka, G.M., 1976, Geohydrologic Maps of the Potomac-Raritan-Magothy Aquifer System in the New Jersey Coastal Plain, Hydrologic Investigations Atlas 557.

8. Thomas, D.M. and Tice, R.H., 1964, Floods on the Raritan and Millstone rivers in Somerset County, New Jersey, Hydrologic Investigations Atlas 104.

9. Anderson, P.W. et. al., 1974, Water Quality and Streamflow characteristics, Raritan River Basin, New Jersey, Water Resources Investigations 14-74, 82 p.

10. Anderson, O.W. and Subitzky, S., 1973, Remote-Sensing Studies of Hydrologic Environments in the Lower Raritan River System, New Jersey. (open-file report) 17 p.

11. New Jersey Department of Environmental Protection, Green Acres Procedural Guide, Local Assistance Program.

12. NOAA Nautical Charts of Raritan Bay and Southern Part of Arthur Kill, 1979.

13. NOAA Nautical Chart of the Raritan River-Raritan Bay to New Brunswick, 1979.

14. U.S.G.S. 7½ minute quadrangle maps
    Arthur Kill
    Keyport
    South Amboy
    Perth Amboy

15. NOAA Tide Tables, 1981, East Coast of North America and South America.

16. NOAA Tidal Current Charts for New York Harbor, Eighth Edition 1979.

17. NOAA and the Department of Defense, 1979, Chart No.1- Nautical Chart Symbols and Abbreviations , 36 p.

18. New Jersey Dept. of Environmental Protection, Division of Costal Resources and NOAA, Coastal Zone Management, 1980, New Jersey Coastal Management Program and Final Impact Statement (CAFRA), 533 p. (On loan to SA).

19. Interstate Sanitation Commission, 1980, Report of the Interstate Sanitation Commission on the Water Pollution Control Activities and the Interstate Air Pollution Program.

20. Soil Conservation Service and N.J. Department of Environmental Protection, 1980, Endangered and Threatened Species of New Jersey, 44 p.

Publications

1. Soils Report for Central Maintenance Shop Building, Sewaren Generating Station, Sewaren, N.J., 1978.

2. Sewaren Generating Station - Units 7 and 8: Plan and Location of Borings, Boring Logs, Geologic Sections, Excavation and Fill Sections, Soundings.

3. Hardt, W.F. and Jablonski, L.A., 1959, Results of a Pumping Test in the Vicinity of Woodbridge, Middlesex County, N.J. U.S. Geological Survey open-file report, 8 p.

4. Woodbridge Township, 1978, Master Plan of Woodbridge Townships - Community Facilities Plan and Land Use Element, 31 p.

5. Metcalf and Eddy, Inc., 1973, Report to Township of Woodbridge on the Feasibility of Local Environmental Regulations, Phase I Appendix.

6. Princeton Aqua Service, 1981, Wetlands/Floodplain Evaluations, Woodbridge Township, Middlesex County, N.J.

Maps, Charts and Plans

1. 100 scale print of Existing Topography at Sewaren Peninsula (2 foot contours).

2. 100 scale Plan of Elevations at Sewaren Peninsula

3. 100 scale Plan of Sewaren Peninsula Riparian Boundary Survey

4. Woodbridge Township Tax Maps (10/1/80)

5. 200 scale original mylar of Sewaren Peninsula and surrounding area.

   a. Two prints of Sewaren Peninsula and surrounding area.

   b. One large print of Sewaren Peninsula and surrounding area with streets labeled.

6. Woodbridge Township Zoning Map

7. Survey of Riparian Rights Boundary on Sewaren Peninsula - one copy (Apparently there are two copies of a riparian rights boundary survey. Item 7 shows the boundaries of the small tributary streams within the fill zone of the peninsula.)

Sasaki Associates, Inc., 64 Pleasant Street, Watertown, Massachusetts 02172 · (617) 926-3300 Telex 92-2471
353 Alcazar Avenue, Coral Gables, Florida 33134 · (305) 443-2374

APPENDIX II

SUBSURFACE DATA

LEGEND

BORINGS 1 - 8

Note:

A - Soil Classification
B - Depth at change of strata
C - Sample Number
D - Blows per 6" on 2" sample spoon with 140 lb. hammer falling 30"
WL - Water Level
Scale Vert. 1" = 5'

LEGEND

BORINGS 5-7, 16-19, 27, 33-40

Distance Hammer Drop	on Casing	24 inch
	on Sampler	20 inch
Drive Hammer		200 lbs.
Sampler Hammer		140 lbs.
Casing Size		4 inch
Sampler Size		2 inch
Site of Core Bit		NX inch

Column 1 Denotes sample or core run numbers.

Column 2 Denotes elevations at top & bottom of each sample or core run.

Column 3 Denotes sample blows per six inches or % of core recovery.

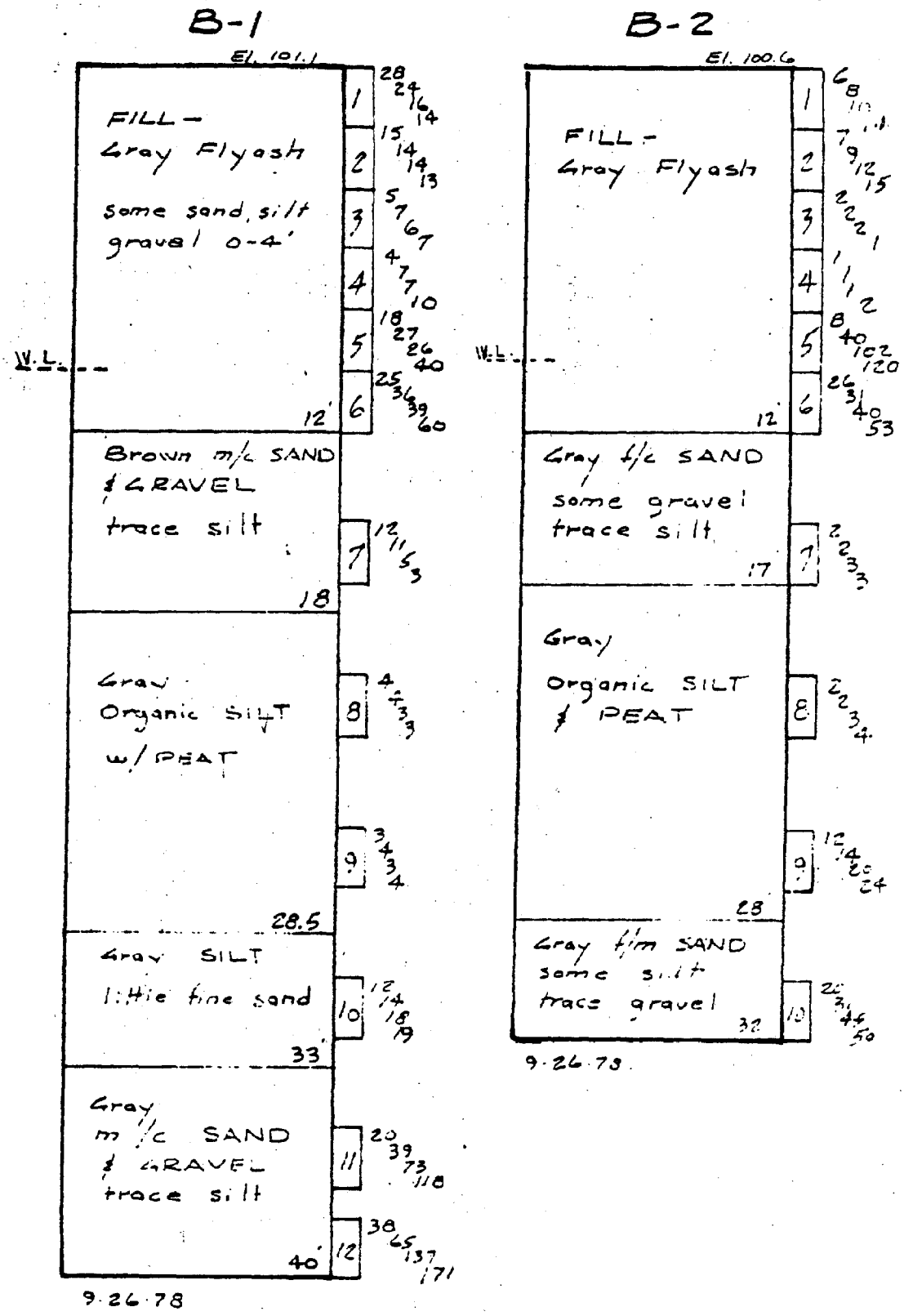
Column 4 Denotes length of sample or core recovered.

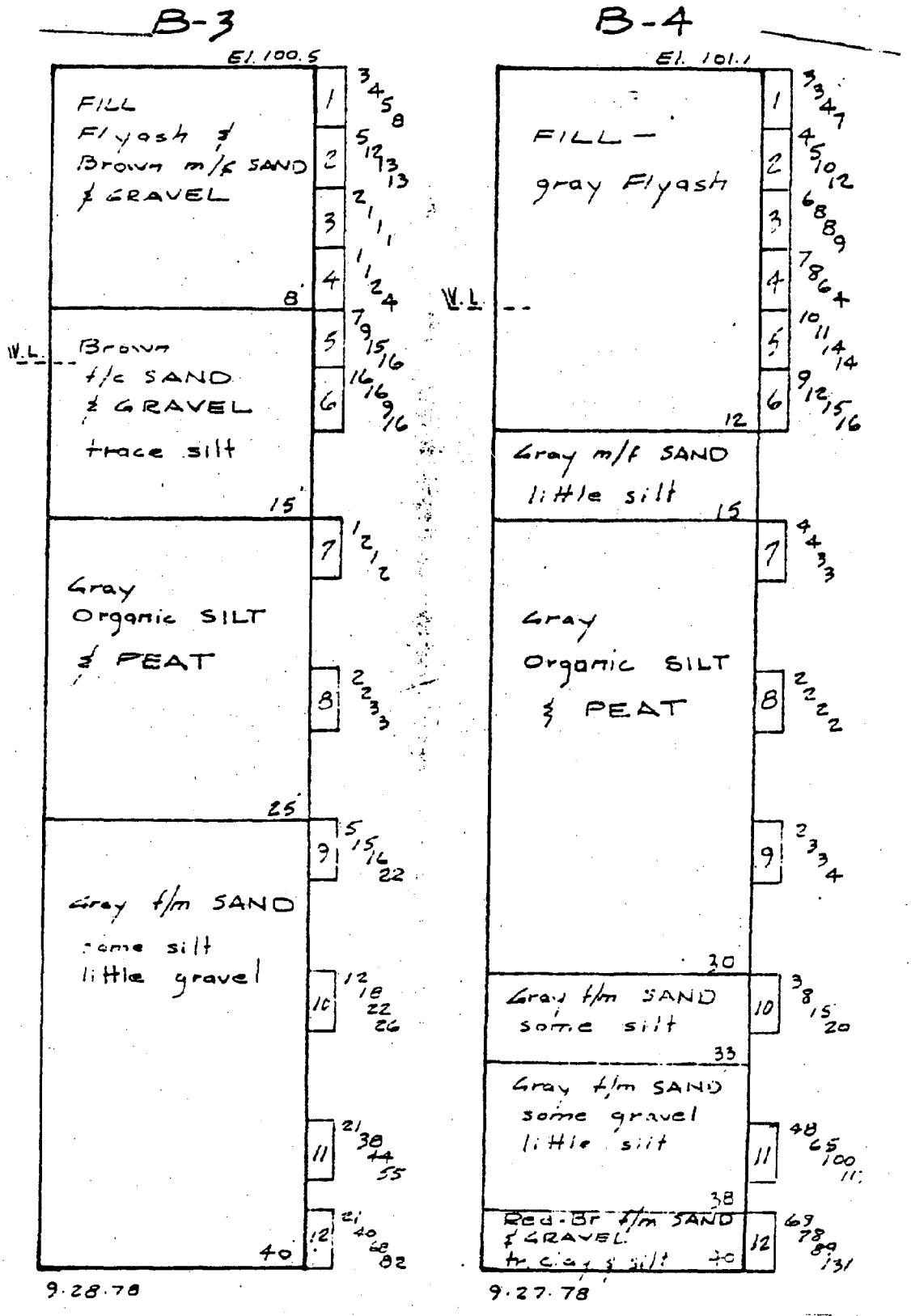
Column 5 Denotes casing blows per foot.

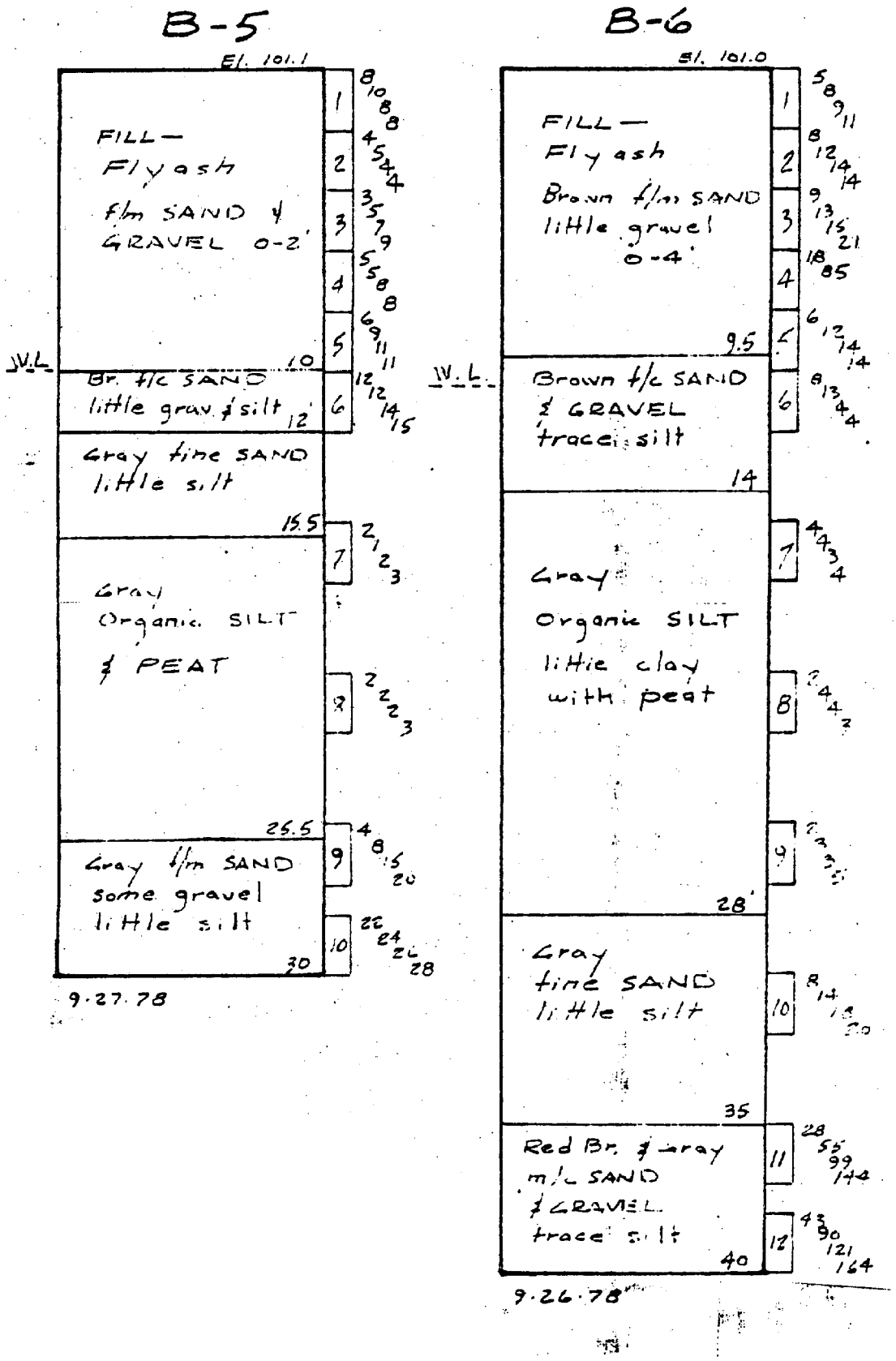
Vertical Scale 1" = 5'0"

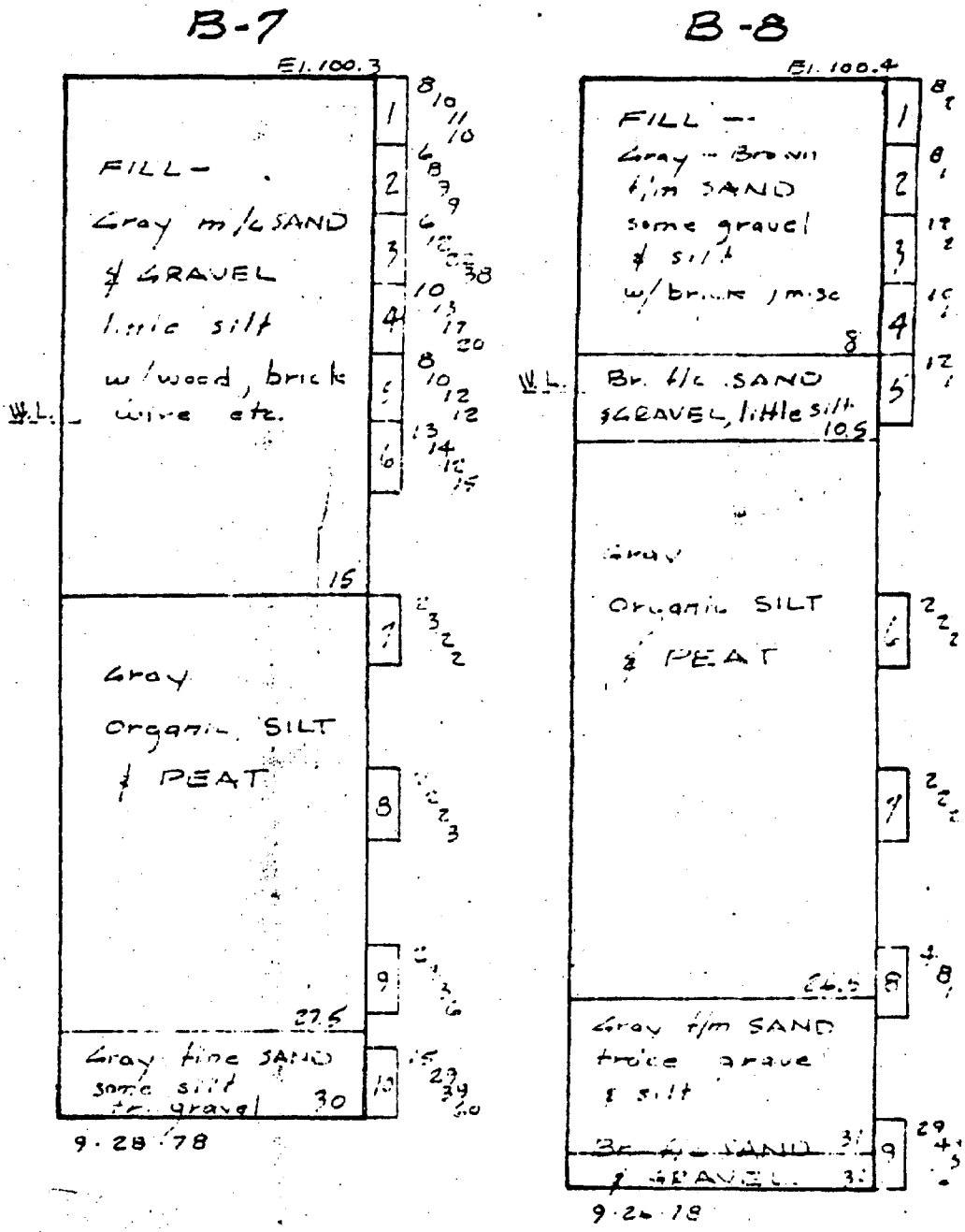
GW Ground Water Level

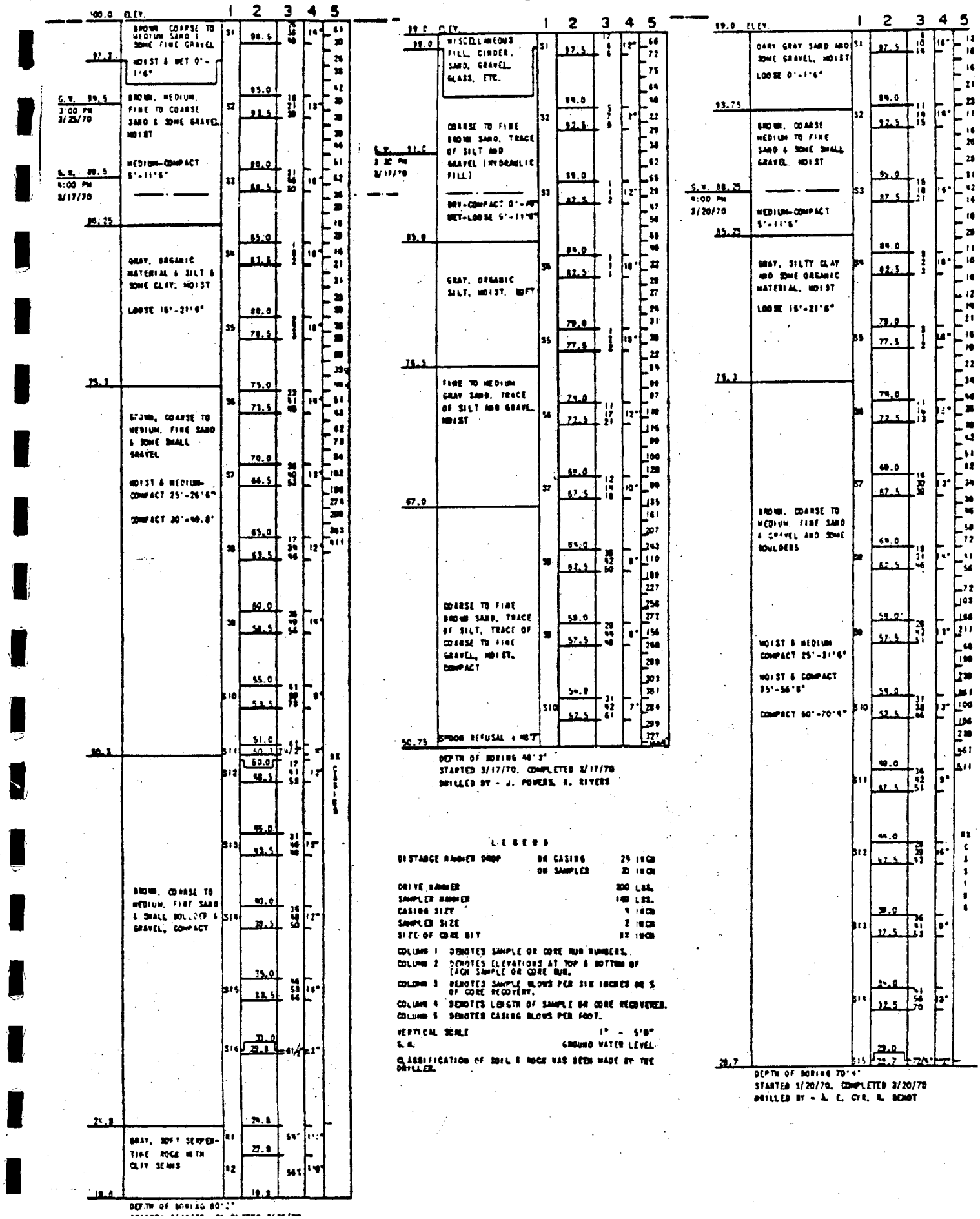
Classification of soil & rock has been made by the driller.

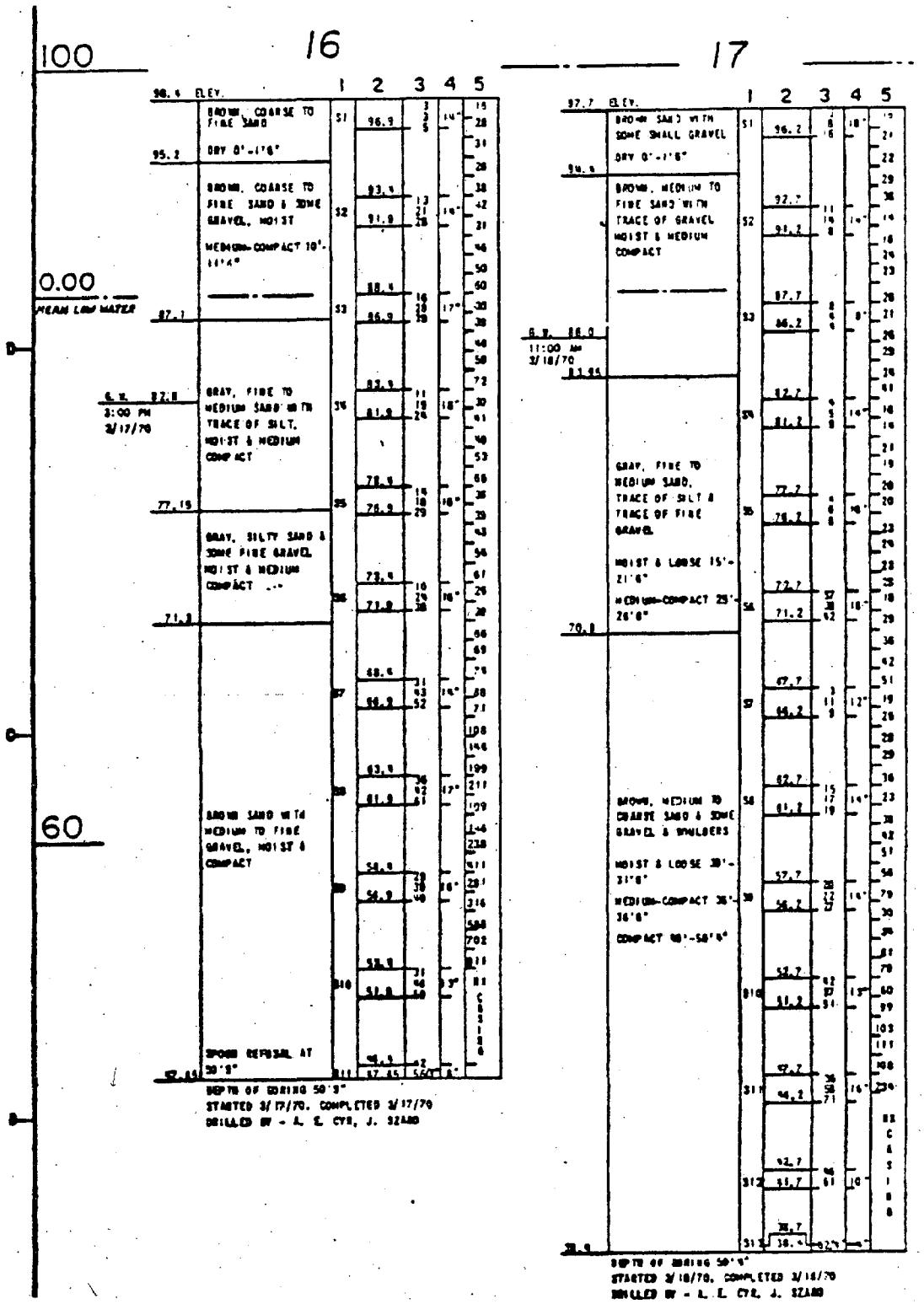

B-1
El. 101.1
FILL -
Gray Flyash
some sand, silt
gravel 0-4'
W.L.
12'
Brown m/c SAND
& GRAVEL
trace silt
18'
Gray
Organic SILT
w/ PEAT
28.5'
Gray SILT
little fine sand
33'
Gray
m/c SAND
& GRAVEL
trace silt
40'
1 28 24 6 14
2 15 14 14 13
3 5 7 6 7
4 4 7 7 10
5 18 27 26 40
6 25 36 39 60
7 12 11 5 3
8 4 4 3 3
9 3 4 3 4
10 12 14 18 19
11 20 39 73 118
12 38 65 137 171
9-26-78
B-2
El. 100.6
FILL -
Gray Flyash
W.L.
12'
Gray f/c SAND
some gravel
trace silt
17'
Gray
Organic SILT
& PEAT
28'
Gray f/m SAND
some silt
trace gravel
38'
1 6 8 10 11
2 7 9 12 15
3 2 2 2 1
4 1 1 1 2
5 8 40 102 120
6 26 31 40 53
7 2 2 3 3
8 2 2 3 4
9 12 14 22 24
10 26 31 46 50
9-26-78


B-3
El. 100.5
FILL
Flyash &
Brown m/f SAND
& GRAVEL
8'
W.L.
Brown
f/c SAND
& GRAVEL
trace silt
15'
Gray
Organic SILT
& PEAT
25'
Gray f/m SAND
some silt
little gravel
40'
1 3 4 5 8
2 5 12 13 13
3 2 1 1 1
4 1 1 2 4
5 7 9 15 16
6 16 16 9 16
7 1 2 1 2
8 2 2 3 3
9 5 15 16 22
10 12 18 22 26
11 21 38 44 55
12 21 40 68 82
9-28-78
B-4
El. 101.1
FILL -
gray Flyash
W.L.
12'
Gray m/f SAND
little silt
15'
Gray
Organic SILT
& PEAT
30'
Gray f/m SAND
some silt
33'
Gray f/m SAND
some gravel
little silt
38'
Red-Br f/m SAND
& GRAVEL
tr clay & silt
40'
1 3 3 4 7
2 4 5 10 12
3 6 8 8 9
4 7 8 6 +
5 10 11 14 14
6 9 12 15 16
7 4 4 3 3
8 2 2 2 2
9 2 3 3 4
10 3 8 15 20
11 48 65 100 11
12 69 78 89 131
9-27-78

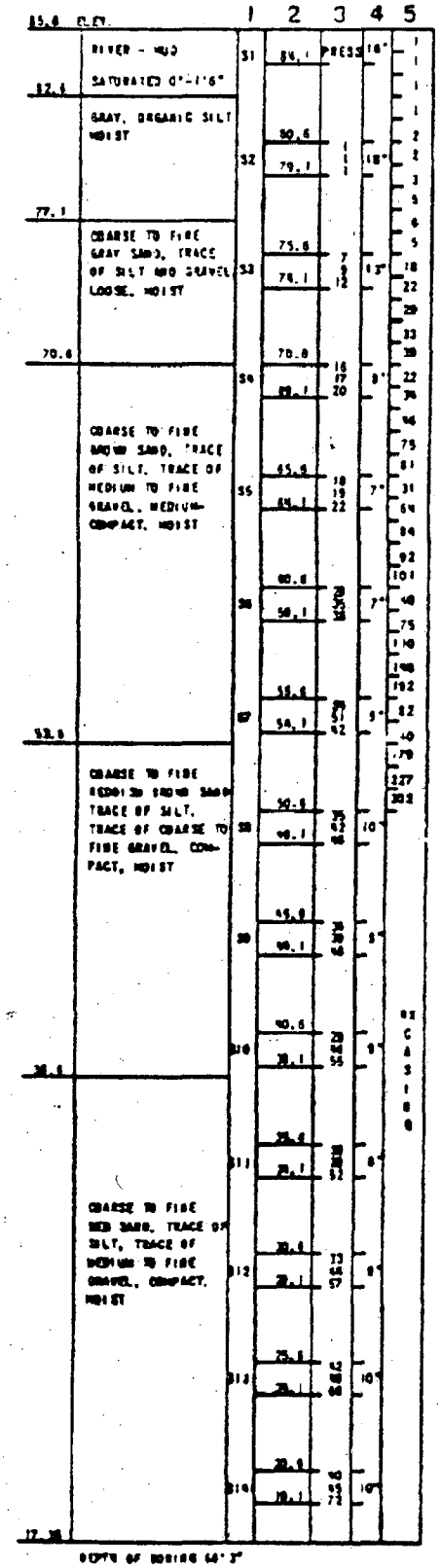

B-5
El. 101.1
FILL—
Fly ash
f/m SAND & GRAVEL 0-2'
W.L.
10
Br. f/c SAND
little grav. & silt
12'
Gray fine SAND
little silt
15.5
Gray
Organic SILT
& PEAT
25.5
Gray f/m SAND
some gravel
little silt
30
9-27-78
B-6
El. 101.0
FILL—
Fly ash
Brown f/m SAND
little gravel
0-4'
9.5
W.L.
Brown f/c SAND
& GRAVEL
trace silt
14
Gray
Organic SILT
little clay
with peat
28'
Gray
fine SAND
little silt
35
Red Br. & Gray
m/c SAND
& GRAVEL
trace silt
40
9-26-78


B-7
El. 100.3
FILL -
Gray m/c SAND
& GRAVEL
little silt
w/ wood, brick
wire etc.
W.L.
15
Gray
Organic SILT
& PEAT
27.5
Gray fine SAND
some silt
& gravel
30
9-28-78
B-8
El. 100.4
FILL --
Gray - Brown
f/m SAND
some gravel
& silt
w/ brick misc
8
W.L.
Br. f/c SAND
& GRAVEL, little silt
10.5
Gray
Organic SILT
& PEAT
24.5
Gray f/m SAND
trace gravel
& silt
Br. f/c SAND
& GRAVEL
31
9-26-78

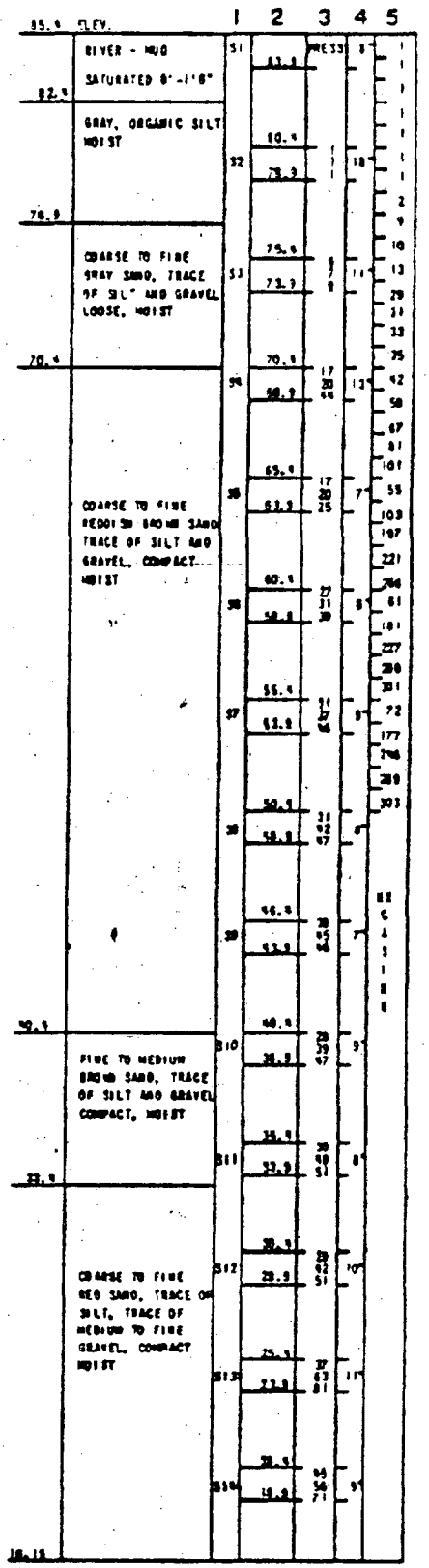

5
100.0 ELEV.
BROWN COARSE TO MEDIUM SAND & SOME FINE GRAVEL
MOIST & WET 0'-11'6"
97.2
G.W. 99.5 3:00 PM 3/25/70
BROWN, MEDIUM, FINE TO COARSE SAND & SOME GRAVEL MOIST
MEDIUM-COMPACT 5'-11'6"
G.W. 99.5 9:00 PM 3/17/70
95.25
GRAY, ORGANIC MATERIAL & SILT & SOME CLAY, MOIST
LOOSE 15'-21'6"
75.3
BROWN, COARSE TO MEDIUM, FINE SAND & SOME SMALL GRAVEL
MOIST & MEDIUM-COMPACT 25'-26'6"
COMPACT 30'-60.8'
60.3
BROWN, COARSE TO MEDIUM, FINE SAND & SMALL BOULDER & GRAVEL, COMPACT
21.8
GRAY, SOFT SERPENTINE ROCK WITH CLAY SEAMS
19.8
DEPTH OF BORING 80'2"
6
99.0 ELEV.
98.0
MISCELLANEOUS FILL, CINDER, SAND, GRAVEL, GLASS, ETC.
G.W. 91.0 3:30 PM 3/17/70
COARSE TO FINE BROWN SAND, TRACE OF SILT AND GRAVEL (HYDRAULIC FILL)
DRY-COMPACT 0'-MP WET-LOOSE 5'-11'6"
89.0
GRAY, ORGANIC SILT, MOIST, SOFT
76.5
FINE TO MEDIUM GRAY SAND, TRACE OF SILT AND GRAVEL, MOIST
67.0
COARSE TO FINE BROWN SAND, TRACE OF SILT, TRACE OF COARSE TO FINE GRAVEL, MOIST, COMPACT
50.75
SPOON REFUSAL + 48"
DEPTH OF BORING 48'3"
STARTED 3/17/70, COMPLETED 3/17/70
DRILLED BY - J. POWERS, H. RIVERS
LEGEND
DISTANCE HAMMER DROP — 6B CASING 24 INCH; 6B SAMPLER 30 INCH
DRIVE HAMMER 300 LBS.
SAMPLER HAMMER 140 LBS.
CASING SIZE 6 INCH
SAMPLER SIZE 2 INCH
SIZE OF CORE BIT BX INCH
COLUMN 1 DENOTES SAMPLE OR CORE RUN NUMBERS.
COLUMN 2 DENOTES ELEVATIONS AT TOP & BOTTOM OF EACH SAMPLE OR CORE RUN.
COLUMN 3 DENOTES SAMPLE BLOWS PER SIX INCHES OR % OF CORE RECOVERY.
COLUMN 4 DENOTES LENGTH OF SAMPLE OR CORE RECOVERED.
COLUMN 5 DENOTES CASING BLOWS PER FOOT.
VERTICAL SCALE 1" - 5'0"
G.W. GROUND WATER LEVEL
CLASSIFICATION OF SOIL & ROCK HAS BEEN MADE BY THE DRILLER.
7
99.0 ELEV.
DARK GRAY SAND AND SOME GRAVEL, MOIST
LOOSE 0'-11'6"
93.75
BROWN, COARSE MEDIUM TO FINE SAND & SOME SMALL GRAVEL, MOIST
G.W. 88.25 9:00 PM 3/20/70
MEDIUM-COMPACT 5'-11'6"
85.25
GRAY, SILTY CLAY AND SOME ORGANIC MATERIAL, MOIST
LOOSE 15'-21'6"
75.3
BROWN, COARSE TO MEDIUM, FINE SAND & GRAVEL AND SOME BOULDERS
MOIST & MEDIUM COMPACT 25'-31'6"
MOIST & COMPACT 35'-56'6"
COMPACT 60'-70'6"
28.7
DEPTH OF BORING 70'4"
STARTED 3/20/70, COMPLETED 3/20/70
DRILLED BY - A. E. CYR, R. BENOIT


100
0.00
MEAN LOW WATER
60
16
98.4 ELEV.
BROWN, COARSE TO FINE SAND
DRY 0'-1'6"
95.2
BROWN, COARSE TO FINE SAND & SOME GRAVEL, MOIST
MEDIUM-COMPACT 10'-11'6"
87.1
G.W. 87.8
3:00 PM
3/17/70
GRAY, FINE TO MEDIUM SAND WITH TRACE OF SILT, MOIST & MEDIUM COMPACT
77.15
GRAY, SILTY SAND & SOME FINE GRAVEL MOIST & MEDIUM COMPACT
71.9
BROWN SAND WITH MEDIUM TO FINE GRAVEL, MOIST & COMPACT
SPOON REFUSAL AT 50'8"
47.65
DEPTH OF BORING 50'8"
STARTED 3/17/70, COMPLETED 3/17/70
DRILLED BY - A. E. CYR, J. SZABO
17
97.7 ELEV.
BROWN SAND WITH SOME SMALL GRAVEL
DRY 0'-1'6"
96.1
BROWN, MEDIUM TO FINE SAND WITH TRACE OF GRAVEL MOIST & MEDIUM COMPACT
G.W. 88.0
11:00 AM
3/18/70
83.95
GRAY, FINE TO MEDIUM SAND, TRACE OF SILT & TRACE OF FINE GRAVEL
MOIST & LOOSE 15'-21'6"
MEDIUM-COMPACT 25'-26'6"
70.8
BROWN, MEDIUM TO COARSE SAND & SOME GRAVEL & BOULDERS
MOIST & LOOSE 30'-31'6"
MEDIUM-COMPACT 35'-36'6"
COMPACT 48'-48'6"
38.9
DEPTH OF BORING 50'8"
STARTED 3/18/70, COMPLETED 3/18/70
DRILLED BY - A. E. CYR, J. SZABO

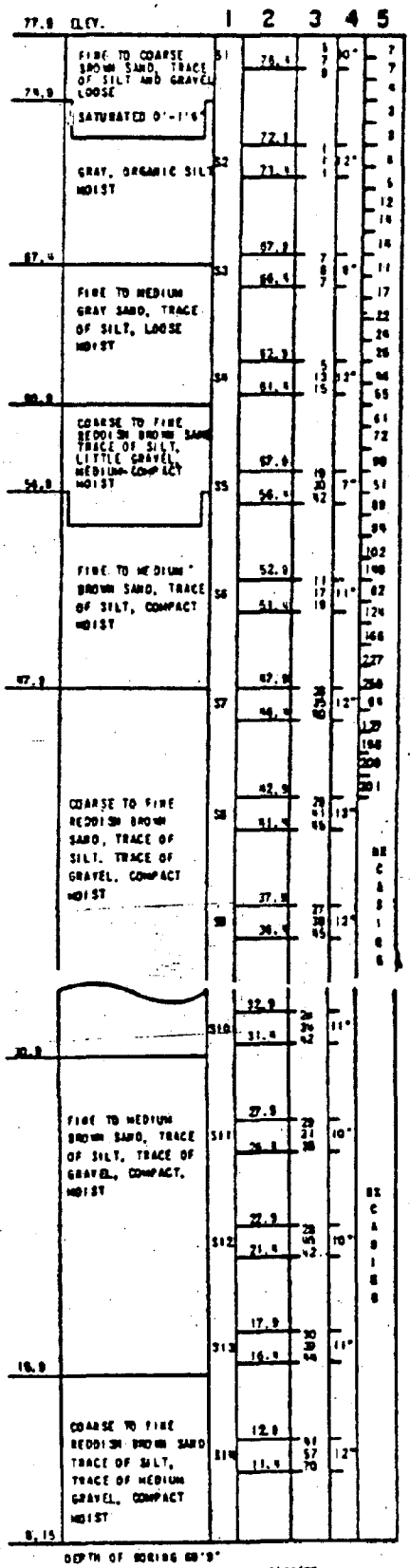
18


85.6 ELEV.
1 2 3 4 5
RIVER - MUD
SATURATED 0'-1'6"
82.4
GRAY, ORGANIC SILT MOIST
77.1
COARSE TO FINE GRAY SAND, TRACE OF SILT AND GRAVEL LOOSE, MOIST
70.6
COARSE TO FINE BROWN SAND, TRACE OF SILT, TRACE OF MEDIUM TO FINE GRAVEL, MEDIUM-COMPACT, MOIST
53.6
COARSE TO FINE REDDISH BROWN SAND TRACE OF SILT, TRACE OF COARSE TO FINE GRAVEL, COMPACT, MOIST
38.6
COARSE TO FINE RED SAND, TRACE OF SILT, TRACE OF MEDIUM TO FINE GRAVEL, COMPACT, MOIST
17.35
DEPTH OF BORING 68'3"
STARTED 2/19/70. COMPLETED 2/20/70
DRILLED BY - J. POWERS, R. RIVERS

19

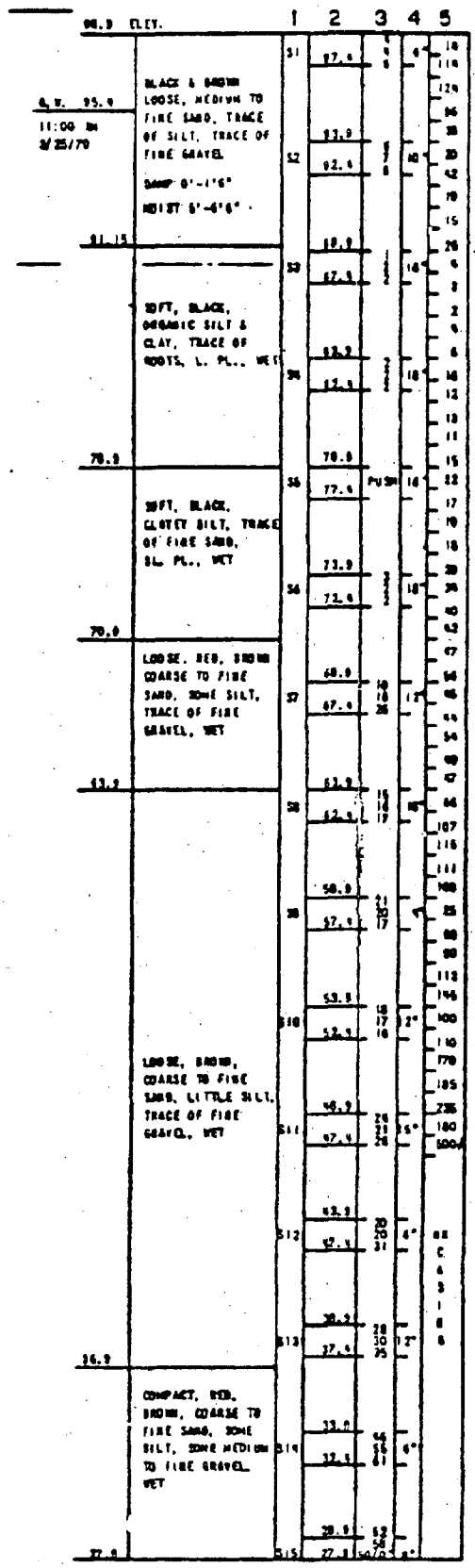

85.4 ELEV.
1 2 3 4 5
RIVER - MUD
SATURATED 0'-1'6"
82.9
GRAY, ORGANIC SILT MOIST
70.9
COARSE TO FINE GRAY SAND, TRACE OF SILT AND GRAVEL LOOSE, MOIST
70.4
COARSE TO FINE REDDISH BROWN SAND TRACE OF SILT AND GRAVEL, COMPACT MOIST
50.9
FINE TO MEDIUM BROWN SAND, TRACE OF SILT AND GRAVEL COMPACT, MOIST
33.9
COARSE TO FINE RED SAND, TRACE OF SILT, TRACE OF MEDIUM TO FINE GRAVEL, COMPACT MOIST
18.15
DEPTH OF BORING 68'3"
STARTED 2/20/70. COMPLETED 2/20/70
DRILLED BY - J. POWERS, R. RIVERS

27



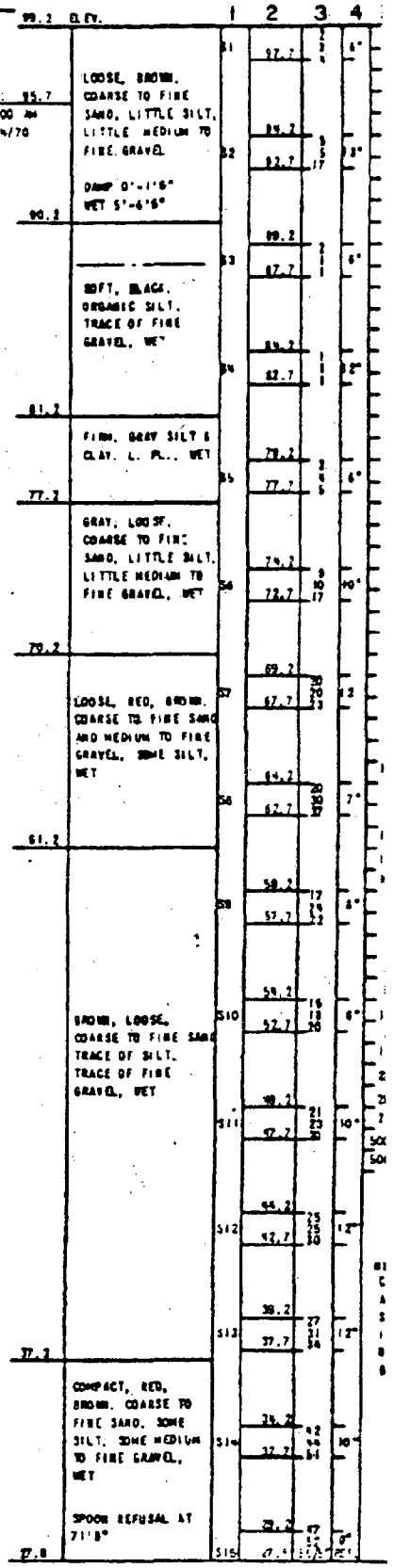
DEPTH OF BORING 68'9"
STARTED 3/23/70, COMPLETED 3/25/70
DRILLED BY - J. POWERS, B. RIVERS

33

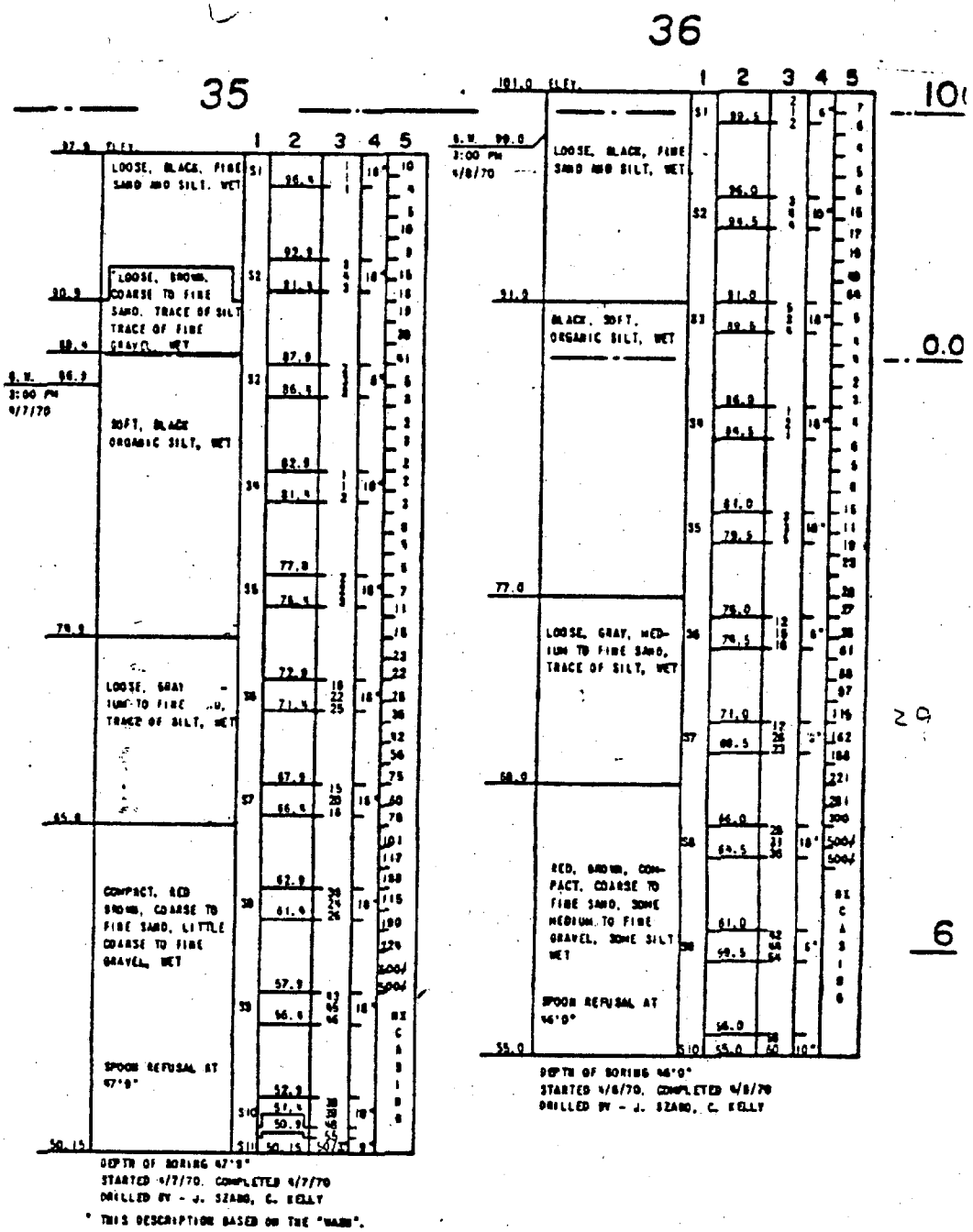


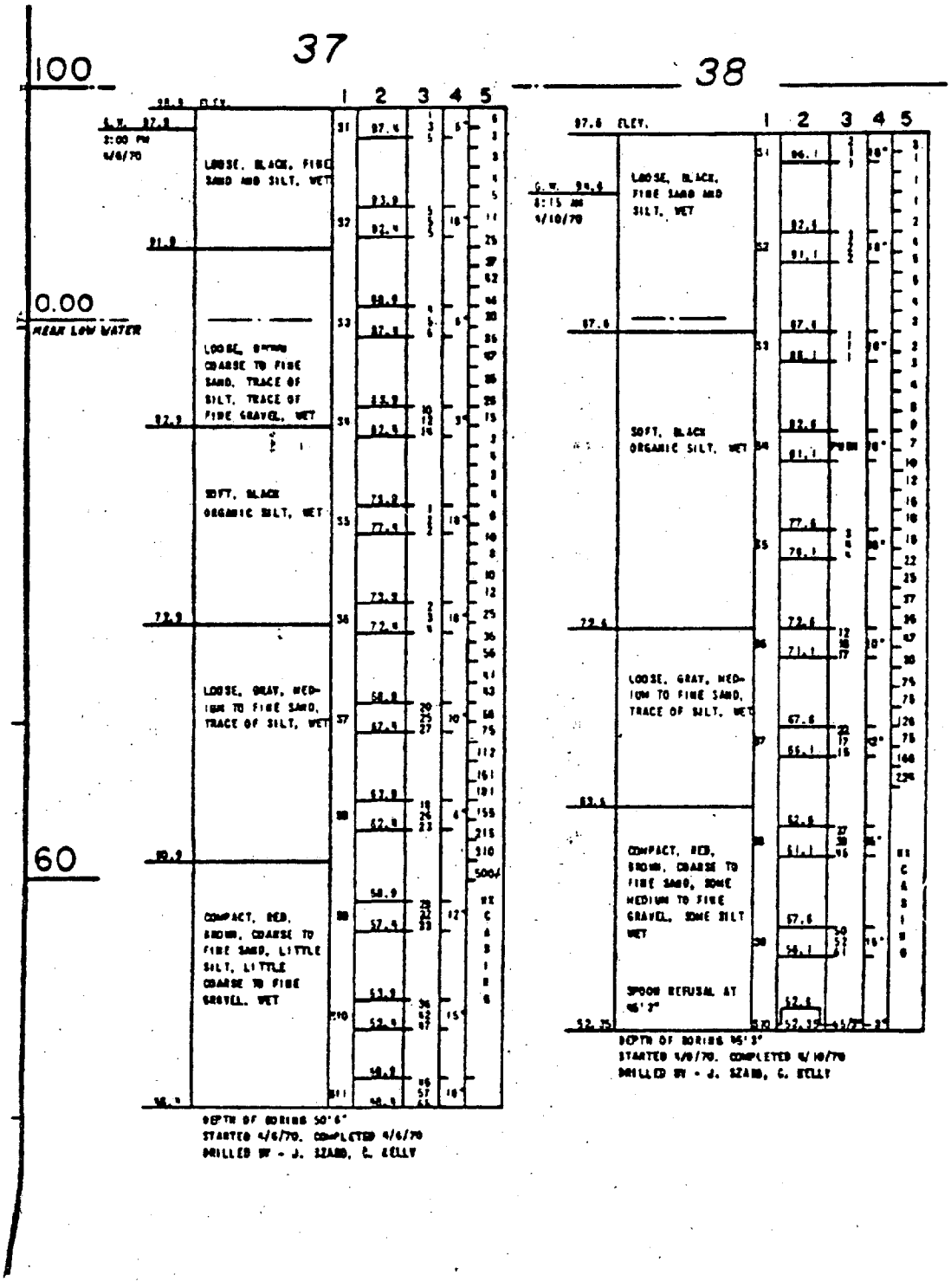
DEPTH OF BORING 71'0"
STARTED 3/24/70, COMPLETED 3/25/70
DRILLED BY - J. SZABO, C. KELLY

34

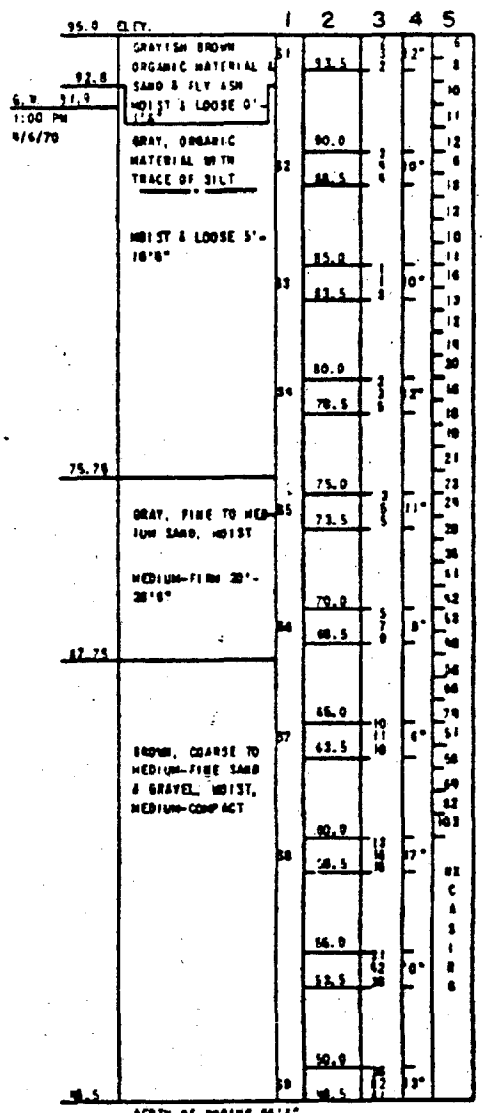


DEPTH OF BORING 71'5"
STARTED 3/23/70, COMPLETED 3/24/70
DRILLED BY - J. SZABO, C. KELLY


35
36
97.9 ELEV.
LOOSE, BLACK, FINE SAND AND SILT, WET
LOOSE, BROWN, COARSE TO FINE SAND, TRACE OF SILT TRACE OF FINE GRAVEL, WET
30.9
68.4
S.W. 96.9 3:00 PM 4/7/70
SOFT, BLACK ORGANIC SILT, WET
79.9
LOOSE, GRAY - TO FINE ... TRACE OF SILT, WET
85.8
COMPACT, RED BROWN, COARSE TO FINE SAND, LITTLE COARSE TO FINE GRAVEL, WET
SPOON REFUSAL AT 67'9"
50.15
DEPTH OF BORING 67'9"
STARTED 4/7/70. COMPLETED 4/7/70
DRILLED BY - J. SZABO, C. KELLY
* THIS DESCRIPTION BASED ON THE "WASH".
101.0 ELEV.
S.W. 99.0 3:00 PM 4/8/70
LOOSE, BLACK, FINE SAND AND SILT, WET
51.0
BLACK, SOFT, ORGANIC SILT, WET
77.0
LOOSE, GRAY, MEDIUM TO FINE SAND, TRACE OF SILT, WET
88.0
RED, BROWN, COMPACT, COARSE TO FINE SAND, SOME MEDIUM TO FINE GRAVEL, SOME SILT WET
SPOON REFUSAL AT 46'0"
55.0
DEPTH OF BORING 46'0"
STARTED 4/8/70. COMPLETED 4/8/70
DRILLED BY - J. SZABO, C. KELLY
1 2 3 4 5
SAMPLE
CASING
10(
0.0
≥ 0
6


37
38
100
0.00
MEAN LOW WATER
60
1 2 3 4 5
LOOSE, BLACK, FINE SAND AND SILT, WET
LOOSE, BROWN COARSE TO FINE SAND, TRACE OF SILT, TRACE OF FINE GRAVEL, WET
SOFT, BLACK ORGANIC SILT, WET
LOOSE, GRAY, MEDIUM TO FINE SAND, TRACE OF SILT, WET
COMPACT, RED, BROWN, COARSE TO FINE SAND, LITTLE SILT, LITTLE COARSE TO FINE GRAVEL, WET
DEPTH OF BORING 50'6"
STARTED 4/6/70. COMPLETED 4/6/70
DRILLED BY - J. SZABO, C. KELLY
LOOSE, BLACK, FINE SAND AND SILT, WET
SOFT, BLACK ORGANIC SILT, WET
LOOSE, GRAY, MEDIUM TO FINE SAND, TRACE OF SILT, WET
COMPACT, RED, BROWN, COARSE TO FINE SAND, SOME MEDIUM TO FINE GRAVEL, SOME SILT WET
SPOON REFUSAL AT 95'3"
DEPTH OF BORING 95'3"
STARTED 4/8/70. COMPLETED 4/10/70
DRILLED BY - J. SZABO, C. KELLY

39

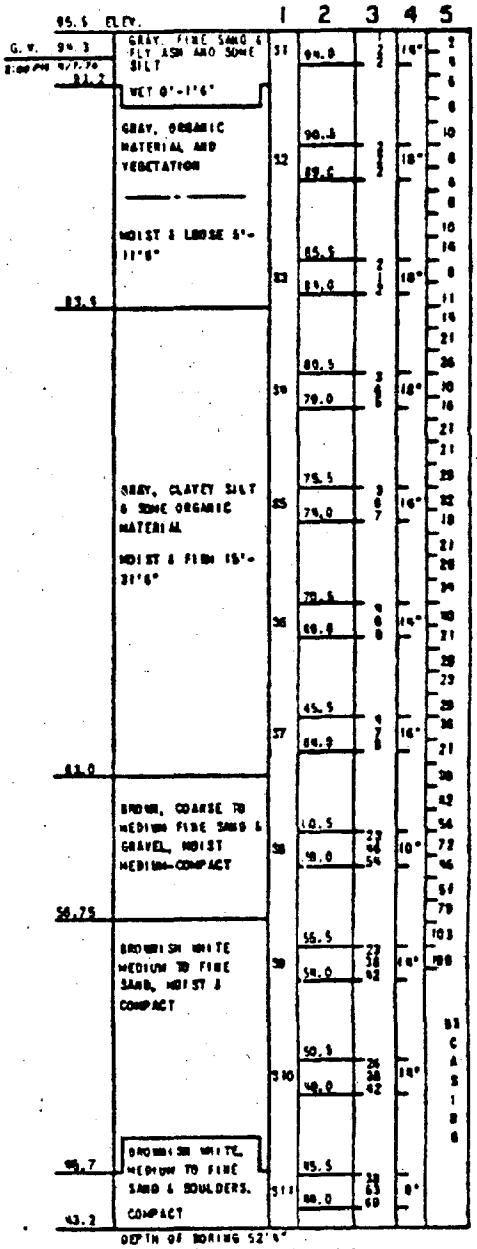


DEPTH OF BORING 46'6"
STARTED 9/3/70, COMPLETED 9/6/70
DRILLED BY- A. E. CYR, W. REES

"0" - 40'-41'6" - MADE 4 SAMPLE ATTEMPTS NO RECOVERY.

USED 300 LB. HAMMER FOR LAST SIX INCHES OF SAMPLE 9.

40



DEPTH OF BORING 52'6"
STARTED 9/6/70, COMPLETED 9/7/70
DRILLED BY - A. E. CYR, W. REES

SPOON REFUSAL AT 52'6" - 100 BLOWS - NO RECOVERY.

CENTRAL MAINTENANCE SHOP BUILDING
SEWAREN GENERATING STATION
SEWAREN, N.J.
AUTHORIZATION # U-50917

SOILS REPORT

SUBMITTED TO:

PUBLIC SERVICE ELECTRIC & GAS COMPANY
60 PARK PL., RM.#716 MP, NEWARK, N.J.

SUBMITTED BY:

JOHNSON SOILS ENGINEERING COMPANY
PALISADES PARK, N.J.

OCTOBER 1978

John C. Mahle

John C. Mahle, P.E.

CENTRAL MAINTENANCE SHOP BUILDING AT SEWAREN GENERATING STATION

I. GENERAL: Subsurface exploration was undertaken at the subject site in order to determine the type and condition of the underlying soil formations as well as their suitability for supporting the proposed structure.

A series of eight borings were made commencing on 26 September 1978 and concluding on 28 September 1978. The borings were made using a hollow stem auger and split barrel sample spoons, 2 inches in diameter. Samples were taken continuously for the first 12 feet and at intervals of five feet thereafter. The borings were made at the locations shown on the "Boring Location Plan and Log of Borings", figure #1.

The site of the proposed structure lies in geologically termed marine terminal marsh. It has been covered over the years with man-made fill.

II. LABORATORY TESTING: In the laboratory all samples were visually classified and grain size analysis and water content tests were made

on representative samples. The results of these tests are shown on figures 2 through 5.

III. FINDINGS: The investigation, examination and testing of the samples reveal the following:

A) A layer of fill was encountered at all boring locations. The fill consisted of fly ash, sand, silt, gravel, wood, bricks, wire and other miscellaneous man-made materials. The fly ash, sand and gravel was the major component. The fill extended from the surface to 12', 12', 8', 12', 10', 9.5', 15' and 8' in holes 1 through 8 respectively. The compaction of this layer varies from very loose to very dense, however due to the composition of the fill material, it is unsuitable as a bearing layer.

Sand or sand and gravel with varying amounts of Silt is encountered from 12' to 18', 12' to 17', 8' to 15', 12' to 15', 10' to 15.5', 9.5' to 14' and 8' to 10.5' in holes 1 through 6 respectively and #8. Bearing capacity on this layer also varies widely, from 0.5 TSF to 3.0 TSF.

Below this layer organic materials are encountered to depths of 28.5', 28', 25', 30', 25.5', 28', 27.5' and 26.5' in 1 through 8 respectively. This layer consists mainly of organic SILT with peat and traces of clay. It is soft and subject to settlement under superimposed loading.

Under the organic layer, granular formations are encountered to the limits of exploration. These formations are composed of silty SAND or sandy SILT with trace to some gravel and are very compact having an allowable bearing capacity of at least 2.5 TSF.

At 33 in hole #1, 38' in #4, 35' in #6 and 31' in #8, the material becomes SAND & GRAVEL with traces of silt and clay. It is very dense with allowable bearing capacity of at least 5 TSF.

B) Water was encountered in all borings and these levels are marked on the Boring Log, figure #1. The level varied from 8' to 10.5' below the ground surface and some variations will occur due to tidal fluctuation.

IV. COMMENTS: Based on the examination of the site, the samples and all other data we would make the following recommendations:

A) The concept of conventional footings for this project should be eliminated. The miscellaneous fill and the deep organic layer will cause excessive settlements to any superimposed structure. Utilization of a surcharge program is not recommended because of the probable time involved and the likelihood of differential settlements after completion of the structure due to the wide variation in live loading, Floor loading as high as 1,000 PSF is anticipated and high column or machine loads of 400 - 500 K plus dynamic loading make spread footings unsuitable.

B) It is recommended that the structure be pile supported with the piles driven to depths ranging from 35 to 45 feet.

The loads involved in the proposed structure preclude the use of timber piles for column support, however, economic analysis may make it desirable to utilize timber piles for slab support. If this choice be made, the piles should be creosoted 8 inch tip piles driven to 25 ton capacity based on the Engineering News formula.

For column support, we recommend steel pipe piles, concrete filled, approximately 40 to 45 feet in length. With piles in the order of 10 inch diameter, capacities of 60 tons can be developed based on the Engineering News formula driving criteria.

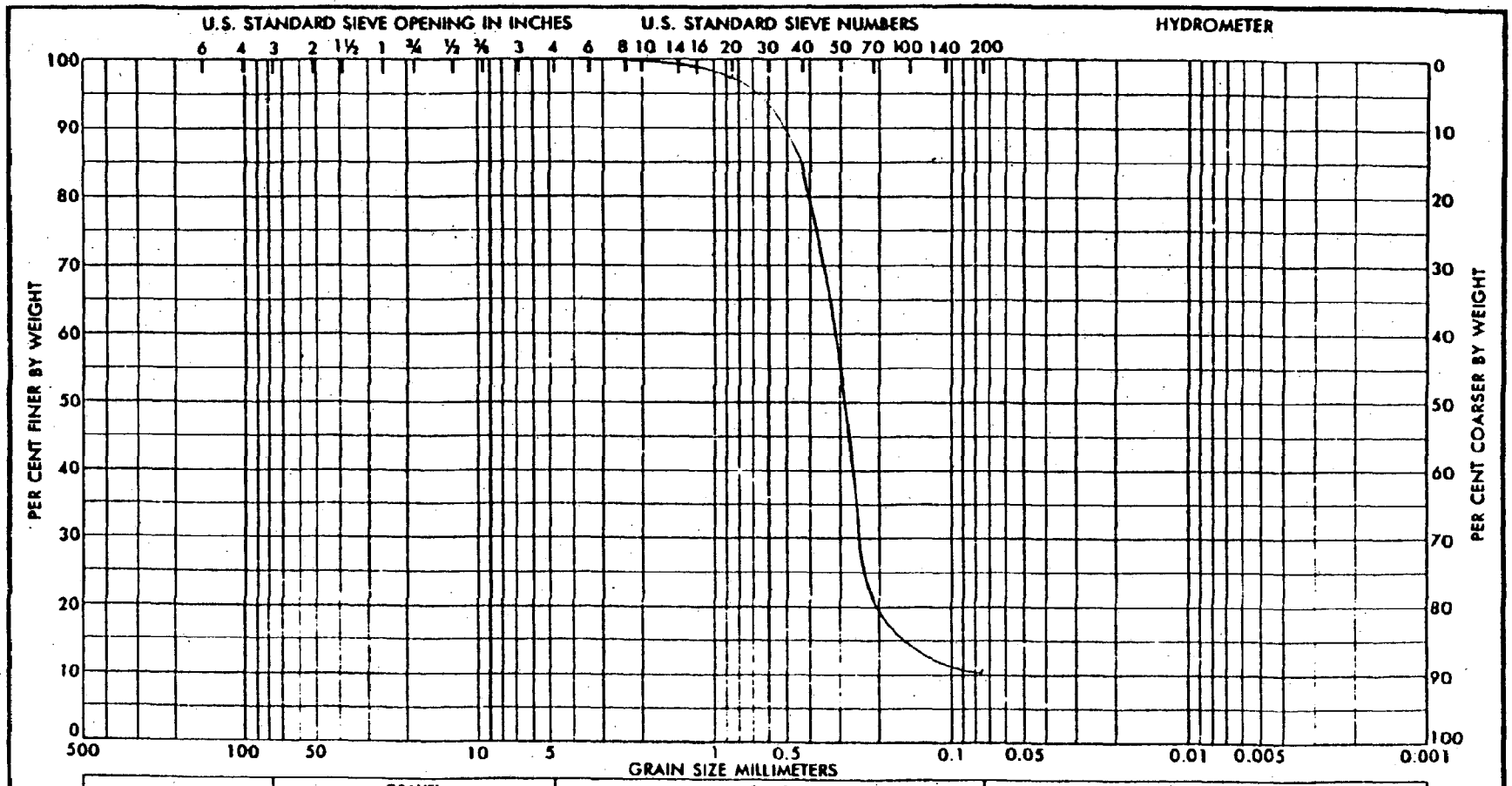
If steel H-piles were used it is likely that the piles would penetrate to rock. The depth to rock was not determined in the investigation since the deep till formations were so dense and compact, that in our opinion additional depth was not warranted.

V. SUMMARY: The following summarizes our findings and conclusions:

A) Conventional footings for the proposed structure should not be used.

B) Support the proposed structure on deep foundations using steel pipe piles, concrete filled for column support.

C) For slab support use either timber or pipe piles depending on economic feasibility determined by designing structural engineer.



SAMPLE NO.	ELEV OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
10	30'-32'	gray fine Sand, little silt	22.1			

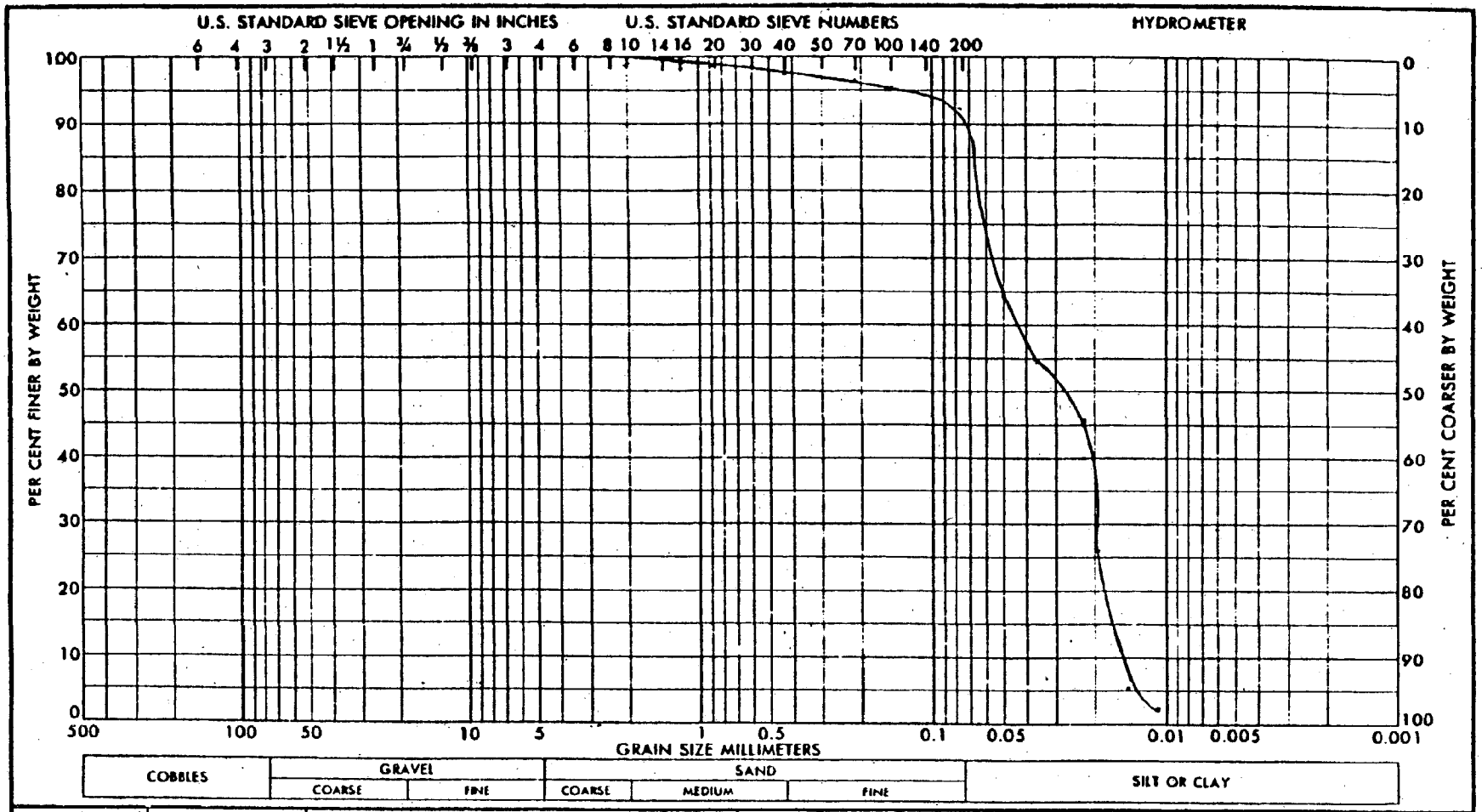
GRADATION CURVES

PROJECT Central Maintenance Shop Bldg. Sewaren Gen. Station

AREA Sewaren, N.J.

BORING NO. 1

DATE October 17, 1978



SAMPLE NO.	ELEV OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
4	6'-8'	gray SILT, tr. f. sand	26.2			

GRADATION CURVES

PROJECT Central Maintenance Shop Bldg, Sewaren Gen. Station

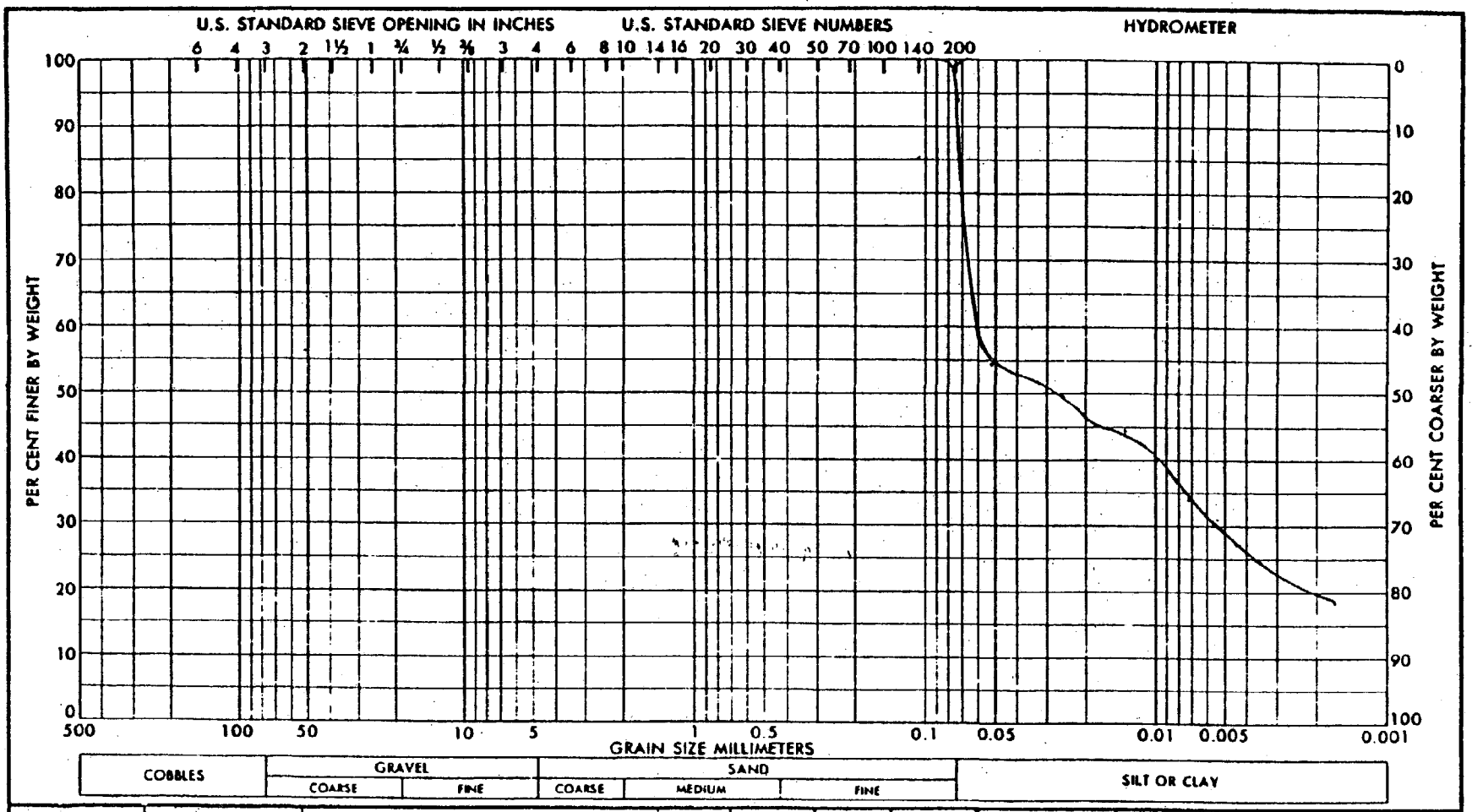
AREA Sewaren, N.J.

BORING NO. 3

DATE October 17,1978

JOHNSON SOILS ENGINEERING LABORATORY

fig. 3



SAMPLE NO	ELEV OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
8	20'-22'	gr. organic SILT, little clay w/peat fibers				

GRADATION CURVES

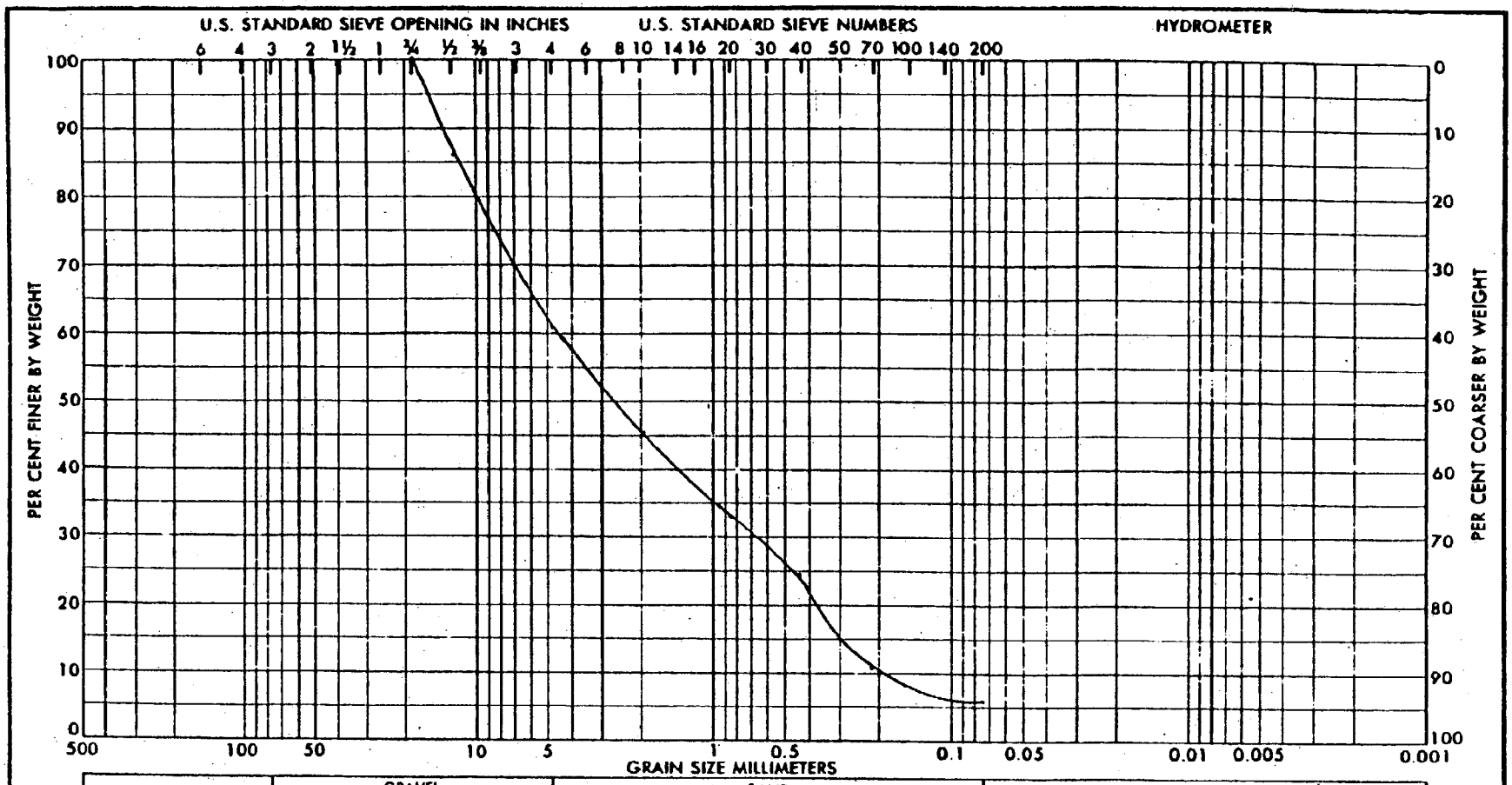
PROJECT Central Maintenance Shop Bldg. Sewaren Gen. Station

AREA Sewaren, N.J.

BORING NO. 7

DATE October 17, 1978

JOHNSON SOILS ENGINEERING LABORATORY



SAMPLE NO.	ELEV OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
9	30'-32'	brown f/c SAND, some gravel tr. silt	9.6			

GRADATION CURVES

PROJECT Central Maintenance Shop Bldg. Sewaren Gen. Station

AREA Sewaren, N.J.

BORING NO. 8

DATE October 17, 1978

JOHNSON SOILS ENGINEERING LABORATORY

APPENDIX III

PROPOSED BORING PROGRAM

SA

Sasaki Associates, Inc., 64 Pleasant Street, Watertown, Massachusetts 02172 · (617) 926-3300 Telex 92-2471

RE: Woodbridge - Subsurface Borings/SA #0278

MEMORANDUM: BY: S. Mabee DATE: 14 September 1981

TO: M. Freedman, M. Holland, L. Carr, E. Chagnon, D. Mittelstadt, V. Hagopian, B. Buttner

I called Warren George, Inc. (James McErlean - 201-433-9797) a drilling outfit and Johnson Soil Engineering to obtain price information on subsurface drilling and soil testing. Johnson Soil Testing did all the work for the Sewaren Generating Station Central Maintenance Shop. Drilling costs are based on the following assumptions:

1. Average boring depth 60'.
2. Split-spoon samples every 5 feet for the first 25 feet, every 10 feet thereafter.
3. Access to the site can be made with an all terrain rig.
4. Observation wells will be installed in selected borings.

Drilling Costs

Mobilization	$500
Soil Boring	$12/LF
Rock Coring	$16/LF
Observation Wells	$ 4/LF
Undisturbed Samples	$65/EA

Soil testing focuses on obtaining general data necessary for determining the following:

1. Unconfined compressive strength.
2. Cohesion.
3. Consolidation characteristics.
4. Moisture characteristics and bearing data.

Soil Testing Costs

Mechanical Sieve Analysis	$20/EA
Mechanical and Hydrometer Analysis	$40/EA
Unconfined Compression	$55/EA
Consolidation Tests	
T_{90} and e log p curves	$300/EA
Moisture Contents (except if part of normal test)	$2/EA
Triaxial Testing (consolidated-undrained)	
(most expensive test)	$100/lateral pressure (usually 3)

SA

Sasaki Associates, Inc., 64 Pleasant Street, Watertown, Massachusetts 02172 · (617) 926-3300 Telex 92-2471

RE: Woodbridge - Subsurface Borings/SA #0278

MEMORANDUM: BY: S. Mabee DATE: 14 September 1981

TO: Page Two

After talking with Mike Holland, Bruce Buttner and looking at the Preliminary Master Plan, I have devised a preliminary boring program. Boring locations have been provided on a sepia and is on record in the flat file.

I propose that a minimum of 8 borings be taken, 5 in the harbor area and at harbor related structures and 3 others at key locations (observation tower, nature pavillion, and fill zone) throughout the peninsula. The following is a summary of the boring program:

1. All borings will be carried to bedrock, or to 10 blow/foot material in cohesive soils and 30 blow/foot material in cohesionless soils, whichever is shallower.

2. For budget purposes an estimated 60 linear feet per hole will be necessary.

3. A minimum of one undisturbed sample shall be taken of cohesive soils from each stratum encountered for each boring.

4. A minimum of one gradation analysis shall be made of soil obtained from each stratum encountered per boring.

5. A minimum of 3 consolidation tests will be conducted. These will be concentrated in areas of proposed filling and structures.

6. A minimum of 3 ground water wells will be installed to monitor ground water fluctuations.

7. Two to three pound grab samples will be collected from the proposed harbor area for bioassay testing related to Corps permitting.

8. Split spoon samples to be taken every 5 feet for the first 25 feet and every 10 feet thereafter or at a change in stratum.

For drilling services we should budget $7,000 to $10,000. An additional allocation of $2,500 to $3,000 should be made for lab testing. Analysis of the data collected during this program can be made by SA personnel. This includes settlement (both magnitude and time rate), strength parameters of soils, establishing

SA

Sasaki Associates, Inc., 64 Pleasant Street, Watertown, Massachusetts 02172 · (617) 926-3300 Telex 92-2471

RE: Woodbridge - Subsurface Borings/SA #0278

MEMORANDUM: BY: S. Mabee DATE: 14 September 1981

TO: Page Three

design criteria. One area where expertise may be needed includes slope stability particularly of sediments located underwater in the area of the harbor edge.

It may be to our advantage to hire a local geotechnical firm to oversee the work. The drilling will require constant supervision.

The estimated cost for SA to oversee the work is about $6,000. If a local geotechnical firm conducts the work to our specification I estimate that the analysis and report work can be accomplished at a cost which is 50% of the field work costs or about $5,600. Total costs are in the order of $15,000 to $20,000.

emc/0278

SA

Planning Architecture Landscape Architecture Urban Design
Civil Engineering Environmental Services

64 Pleasant Street, Watertown, Massachusetts 02172 617/926 3300 Telex 92/2471
353 Alcazar Avenue, Coral Gables, Florida 33134 305/443 2374
2910 M Street NW, Washington, District of Columbia 20007 202/362 9167